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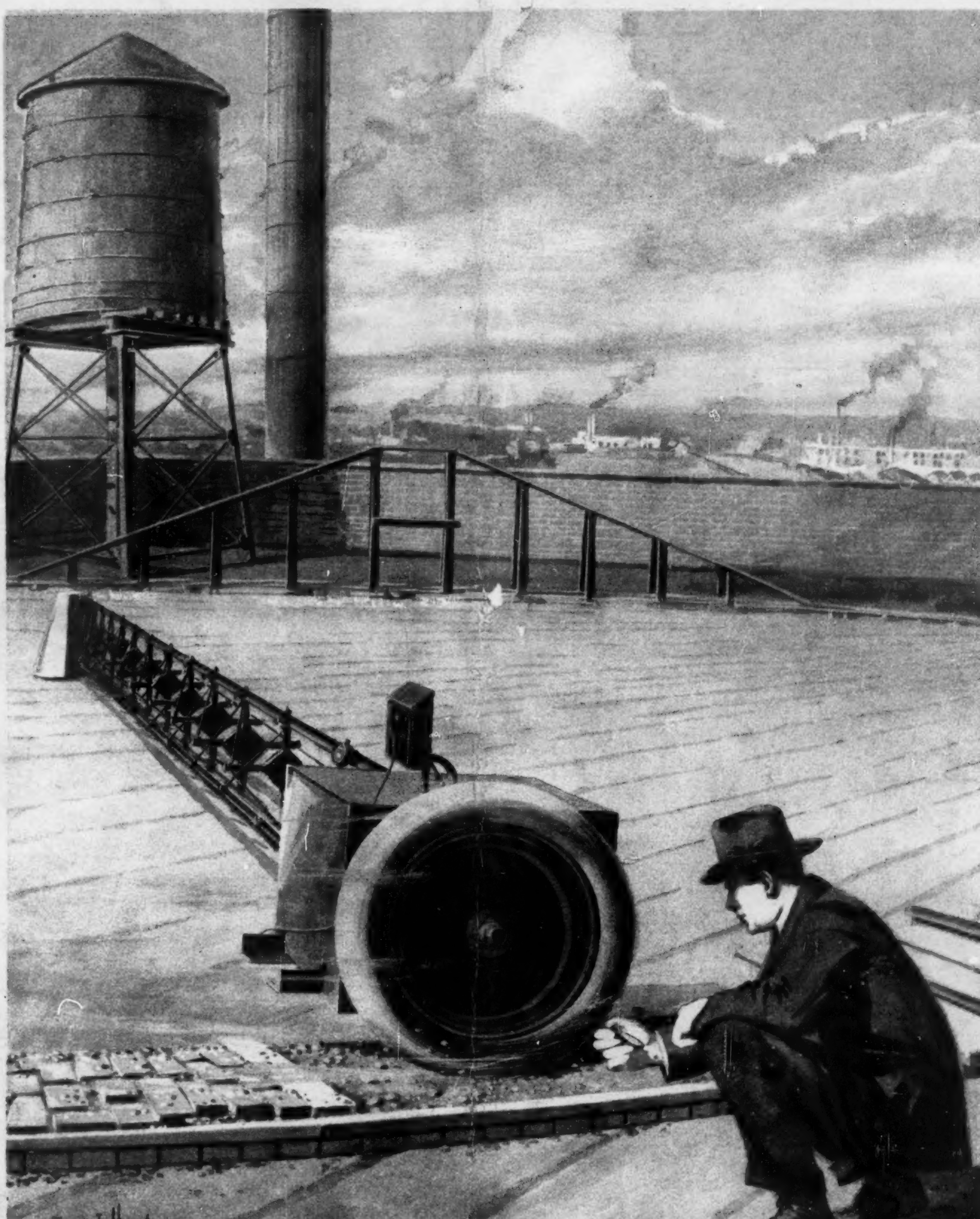

TESTING THE WEARING QUALITIES OF A TIRE ON A FACTORY ROOF [See page 461]

Vol. CXX. No. 18
May 3, 1919

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Price 10 Cents
$5.00 a Year

THE WHITE HEAVY DUTY TRUCK

with

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Having all the leverage and flexibility of a chain and sprocket and the frictionless driving contact of gears which *roll* in oil, dust proof

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advantages of chain and sprocket. This has now been done. The Double Reduction Gear Drive is the full counterpart of chains in *applying* power. It has the chain *pull*, in *gear* form.

The new trucks follow a twofold aim in White design: sturdy engine up in front and maximum pull in the rear. The final drive saves power and therefore fuel. The lubrication saves oil. Light unsprung weight saves tires. Continuous operation saves time of both truck and driver by a steady volume of performance.

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ITE COMPANY

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SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXX.
NUMBER 18

NEW YORK, MAY 3, 1919

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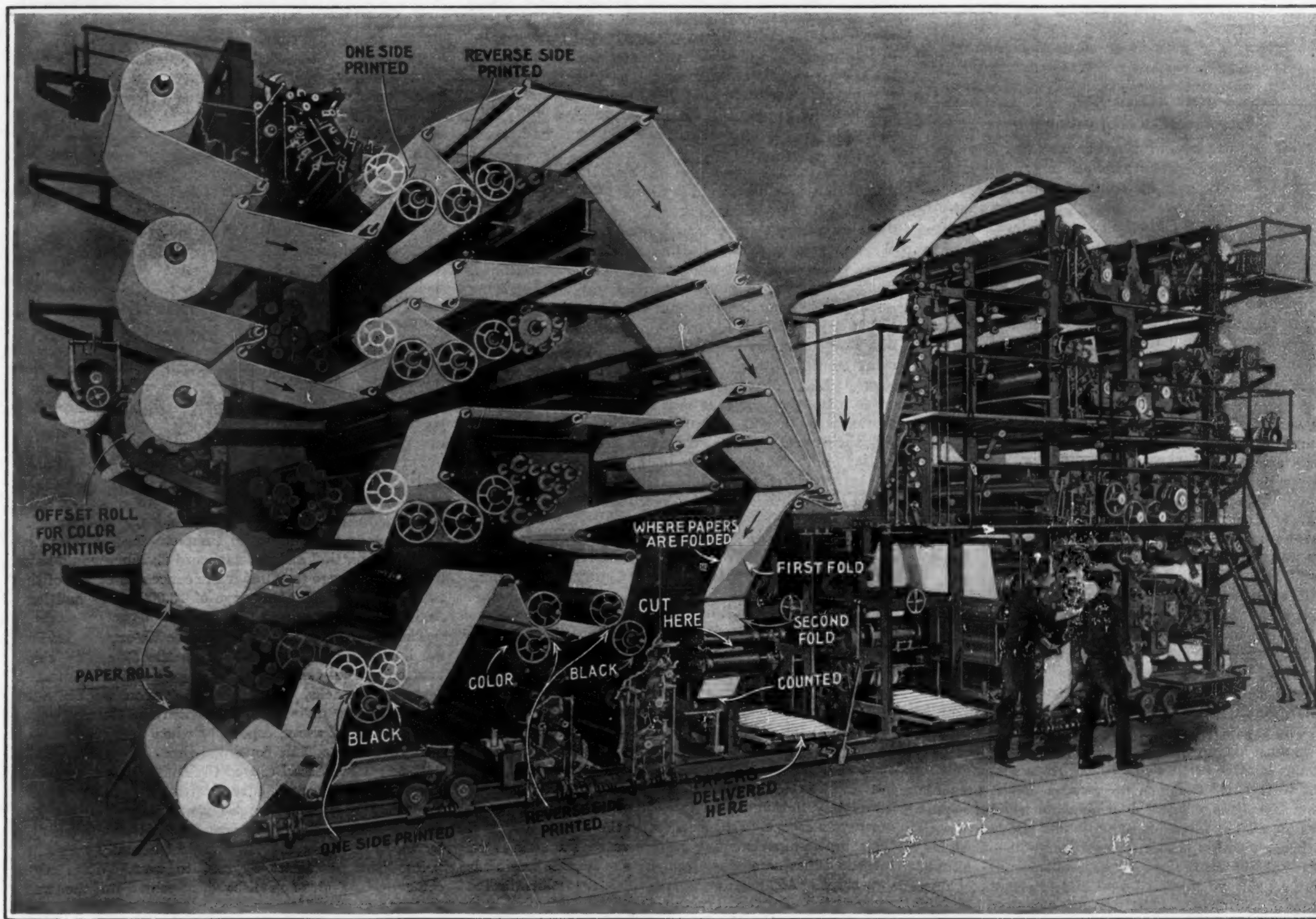

A double octuple and color combination press partly broken away to show the course of the paper webs

Our Largest Newspaper Presses

A VISITOR to the press room of one of our large modern newspapers usually gazes with uncomprehending amazement at the huge and complex machinery. He sees the big rolls of paper melt into swiftly flowing streams which mysteriously take on ink in their course and end up in neatly folded newspapers, counted and ready for delivery.

Our artist has come to the aid of the mystified observer and drawn one of these gigantic newspaper presses with part of the framework and mechanism broken away so that it is possible to follow the course of the paper through the press. Thus illustrated, the machine loses much of its complexity and it is very evident that it is composed of a number of presses of closely similar construction grouped into a single machine, each press printing a separate web of paper. The illustration shows a double octuple and color-combination press, that is, the machine is formed of two octuple sections which may be operated individually or together, and which deliver their product from opposite ends to the middle of the press.

Let us follow the course of the upper web in the left-hand section. Immediately to the right of the paper roll is the ink trough in which there is a composition roller that picks up the ink in a thin film. An oscillating roller periodically touches the roller in the trough and transfers a small amount of ink to a series of rollers which vibrate longitudinally and spread the ink uniformly over a large roller. This in turn transfers the ink to a pair of form rollers which finally deliver the ink to the printing surface. The question of proper and even ink distribution is a most important one, and it is for this reason that such a large number of rollers are required to carry the ink from the trough to the plate cylinder.

The stereotype or electrotype plates are secured to the plate cylinder and the paper is pressed against them by an impression cylinder. This places the printing on the upper side of the web. The paper web then passes under a second impression cylinder which presses it against a second plate cylinder so that the reverse side of the paper is also printed. This second plate cylinder is also inked by a series of rollers which, however, are not all shown in the drawing. The paper web then proceeds to the folder. In the same way all the other webs are printed. Each plate cylinder is wide enough to take four stereotype plates of newspaper size and as a plate extends around only one half of the cylinder, there are eight plates on each cylinder. Thus, there are eight impressions on each side of each web, or 64 page impressions in all, with an additional impression in color on the under side of the lowest web. The same is true of the other section of the press, so that we may have 128 page impressions at a time. This does not mean, however, that a single paper of 128 pages is printed, although this could be done. However, the two sections are usually used as duplicate machines to double the output.

Each section is provided with two folders. Our artist has shown the webs as if they were half of the ordinary width and has illustrated only one of the folding mechanisms. Actually the paper is slit by a revolving knife blade, so that the papers as they come from the

(Continued on page 467)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Is Peace Unconstitutional?

WE do not know whether we favor a League of Nations or not; we are not sure what sort of a League we would have, if we could. But we are entirely clear that in the arguments against the League there is to be found a vast amount of sheer nonsense.

A favorite plea against the League, so far as the United States is concerned, is that it is unconstitutional. The right to make war and peace resides, under our Constitution, with the Congress. If we enter a League of Nations we agree not to make war; and the Congress loses its constitutional rights in the premises. Or, perhaps, the constitutional aspect is not emphasized; perhaps we are solemnly told that we, as a nation, must not give up our God-given privilege of making war when and upon whom we please.

Very good. But what is the difference between a treaty with one nation, and a treaty with a score of nations? Peace can be made only by a treaty, in any event; and *our* treaties, we hope, are binding. So the moment we make a treaty of peace we are bound not to make war, except in defence of the terms of the treaty. Then, whether we put the matter upon the basis of constitutionality, or upon the basis of our own inherent right to make war when we want to, peace is objectionable.

If you can make a peace treaty with one nation, you can make one with a dozen. You can make one with the world. If you can't make a peace treaty on a large scale, you can't make one on a small scale. There is no middle ground; either peace is unconstitutional, or it isn't. So says a correspondent of the New York *Times*, and we must agree with him.

To our humble intellect, it seems just as reasonable to object to law and order on the ground that it prevents us from assaulting our next-door-neighbor when the spirit moves us, that it forces us to settle our grievances with him through a legal procedure which imperils our rights, as it is to object to a League of Nations on a similar ground.

We had always supposed that the prime object of a League of Nations was to prevent war. It seems a trifle curious to have it violently objected to because it threatens to accomplish just that purpose.

What the Weather Man Thinks of Ocean Flying

THERE has of course been voluminous discussion of the trans-Atlantic flight; but with few exceptions this is centered around the mechanical features involved. Now this is altogether necessary and proper; but today the mechanical side of the ocean flight has been developed to precisely the point where consideration of another aspect of the case is in order, too. It is no longer problematical whether a plane can be built for which a flight of trans-Atlantic distance is a physical possibility; this question is conceded to have been answered affirmatively. On the other hand, while we may yet hope for the day when any plane of adequate size that is fit to take the air at all may be pointed for the other side of the world with assurance of getting there, we are still a long way from this consummation.

If, then, *an airplane* today can make the crossing, while a *given airplane* will probably fail, the determining factor between success and failure is external conditions. In the case of the airplane, external conditions means the weather. True, weather conditions have been mentioned freely in connection with the efforts now being made to win that $50,000; but they have been mentioned in a wholly insufficient way. If the weather on its face is bad, the aviator will keep out of the air; if the weather looks as though it might be favorable, he will start, and trust to a benevolent Providence to see him safely across. This does not constitute adequate discussion of a determining factor.

Weather is a complex of temperature, humidity, pressure, wind direction and velocity, precipitation. On all these heads there is much to be said with regard to the difference between conditions at the surface and above it, between conditions over land and over water. There is much to be said, much even to be learned, with regard to average and extreme values under each head mentioned, with regard to seasonal and local and casual variations, with regard to probable values at a given time and place, with regard to the effect of each of these factors upon the functioning of plane and pilot. There are special ramifications to be discussed with regard to fog, its altitude, duration and extent, and with regard to other items of equally special nature.

A compilation of what we know and what we hope to find out under each of these heads is essential to flight across the ocean on any basis other than that of a sporting proposition with death. Accordingly, the United States Weather Bureau has assigned one of its meteorologists to investigate the subject; and among his duties is that of being present at the starting point of trans-Atlantic flight to advise the aviators upon weather conditions. Further than this, he has prepared a statement showing just what bearing the meteorological conditions known and suspected to exist along the probable routes of flight may have upon the success of the venture. This statement considers the various questions which we have suggested, and disposes of them so far as it is possible to do so. On the whole, it is a real contribution to the literature of the subject; and we have decided to print it in the SUPPLEMENT as such. The first installment will appear under the above title in the current issue, and it will be completed next week. It will be found that Mr. Gregg has information and suggestions of extreme value to the ocean flyer.

Jellicoe at Jutland

INTEREST in Admiral Jellicoe's story of the Grand Fleet culminates, of course, in the Battle of Jutland, the account of which is given in the same simple and straightforward fashion that characterizes his whole book. It is evident the Admiral feels that he has nothing to conceal; nothing that calls for apology. He makes the frank admission that in many respects the German fleet, though less numerous, was ship for ship, superior to his own; being more heavily armored, with better under-water protection, possessing better range-finders, better searchlights, a more numerous destroyer fleet (88 destroyers to his own 80), and that it was more completely provided with torpedoes, the German destroyers carrying six torpedoes to the British four, and their battleships carrying from five to six submerged torpedo tubes as against from two to four tubes in his own ships. Although Jellicoe had 27 battleships in line against the German 17, the Germans possessed five destroyers per ship, the British only three per ship.

We give these details because it is very evident that it was the formidable nature of modern torpedo attack that controlled Admiral Jellicoe's tactics both in his deployment on getting within range of the enemy battleship fleet, and also in his disposition of the Grand Fleet for the night, after the German fleet turned away to the west under cover of a protecting smoke screen raised by its destroyer flotillas.

As every one knows, a violent controversy has arisen in Great Britain over these very tactics of Admiral Jellicoe. He is accused of having fought with over-caution. Comparison is made with the dashing attacks which carried Nelson to victory. But, as Jellicoe very justly states, there is no parallel to be drawn between Trafalgar and Jutland. The High Sea Fleet represented everything in the way of first-line ships that Great Britain possessed; for she was absolutley without dreadnought reserves; whereas "in addition to Nelson's force of 26 capital ships and 19 frigates, the navy in 1805 had in commission in home waters and the Mediterranean a yet more numerous fleet of 47 capital ships and 50 frigates." Furthermore, when Trafalgar was fought, an additional 32 ships-of-the-line were building in England and 10 in Russia; whereas only five capital ships were under construction in England when Jutland was fought.

When Jellicoe obtained definite information of the position of the German fleet, he was coming down from the north-east with his battleships disposed in six parallel columns, with a distance of about one mile between columns. The German battleships, in line of battle (single column), were coming up from the south. When first sighted, the head of the German line bore about southeast from the head of the starboard or right column of the British fleet, distance about 13,000 yards. It was now necessary for Jellicoe to deploy, *i. e.*, form his fleet into one long line of battle. This is done by the leading ship of each column turning say 90 degrees to port or starboard, the ships of each column following its leaders. If Jellicoe deployed to the starboard, it would bring his fleet on a converging line, and therefore nearer to the German destroyers; if he deployed to port his fleet would turn somewhat away, and the range would be lengthened. For what seem to us to be sound tactical reasons he deployed to port—and for this he has been most savagely criticized.

But let the Admiral speak for himself: "My first and natural impulse was to form on the starboard wing column, in order to bring the fleet into action at the earliest possible moment; but . . . the sound of gunfire," the German fleet was not yet visible through the mist, showed that "the High Sea Fleet was in such close proximity . . . as to create obvious disadvantages in such a movement. I assumed that the German destroyers would be ahead of their Battle Fleet, and . . . it would be suicidal to place my Battle Fleet in a position where it would be open to attack by destroyers during such a deployment, as such an event would throw the fleet into confusion at a critical moment." In this connection it should be noted that 20 torpedoes passed through a single division of his battleships and were avoided only by quick changes of course.

Further considerations were that the starboard divisions, nearest the enemy, were composed of the earlier ships, "with only indifferent protection as compared with the German capital ships," and since it "would take 20 minutes to complete the formation of the line of battle" and the starboard divisions would have to execute a large turn under the concentrated fire of the best German ships at a range of 13,000 yards and less, Jellicoe deployed to port.

Thereafter, with Beatty and his battle-cruisers leading the line, the great battle between the 55 capital ships was on. The German tactics consisted of repeated destroyer attacks, followed by emission by them of smoke-screens, under cover of which the Germans continually turned away, especially when they came under heavy gun-fire. This continual turning of the German fleet to the starboard caused the action to take place in two roughly concentric curves, with the Germans on the inner and smaller circle; so that in this intermittent daylight action, which was interrupted frequently by the thick haze, the German fleet actually turned 13 points from southeast by east to west. When night came on the German fleet disappeared to the west, hidden by the smoke-screen of its destroyers.

Then followed the night action, for which also Jellicoe has been bitterly criticized—and also warmly defended. His critics claim that in view of his superiority in battleships, he should have dashed in that night and fought a melée action (for such, in the confusion of the night, it would have been) and sunk the whole German fleet. But Admiral Jellicoe thought otherwise. Says he: "The result of night actions between heavy ships must always be very largely a matter of chance. Such an action must be fought at very close range, the decision depending on the course of events in the first few minutes. The greater efficiency of the German searchlights and the greater number of torpedo tubes fitted in enemy ships, combined with his superiority in destroyers, would, I knew, give the Germans the opportunity of scoring heavily at the commencement of such an action."

In view of the fact that there was no reserve of dreadnoughts back of the British fleet, and that upon its superiority depended the whole Allied cause, we believe that the verdict of posterity will endorse his decision to steer for the German coast, intercept the returning High Seas Fleet, and renew the battle under daylight conditions.

Engineering

Dock Gates of Reinforced Concrete.—Owing to the scarcity of timber and steel during the war, the gates for a private dry dock in England were made of reinforced concrete. The dock is 40 feet wide and the gates are 14 feet deep. They are circular in form and despite the 14-foot head of water, are only 3½ inches thick. No waterproofing compound was employed and yet they are said to be perfectly water-tight.

Spray-Painting Corrugated Steel.—The corrugated steel used for airplane hangars in this country and overseas was painted before shipment. Owing to the large quantity of steel, it was out of the question to do this work by hand and machines could not be used on account of the corrugations. For this reason, a spray system of painting was employed. First, the sheets were coated with red lead before being corrugated, and after that they received a coating of green on one side and gray on the other side, applied by means of a jet 14 inches wide.

Wooden Lath Netting.—A novel material for house building has been developed in Norway. A netting is employed, made of wooden laths. The laths are two meters long and eight millimeters square in section, or roughly about $\frac{5}{16}$ths of an inch square. They are bound in a lattice form by means of tinned iron wire and applied to the wooden framing of the building. The netting is plastered with a mixture of sand, lime and plaster of paris, or cement, sand and lime. A number of buildings have been put up in this way and have proved very serviceable, even in severe winter weather.

Oil vs. Coal for Warships.—In a paper recently read before the Burlington Association of Mechanical Engineers, the advantages of oil fuel over coal, for warships, were summarized as follows: For an equal bunker weight the radius of action is increased 50 per cent, and for an equal bunker space, 80 per cent. Oil furnishes up to 83 per cent of thermal efficiency as against 50 per cent for coal. Smoke can be controlled perfectly; when it is desirable, a dense smoke screen can be produced or the smoke can be entirely eliminated. With oil fuel, the boilers can be forced up to 50 per cent above their normal rating. Oil fuel reduces the amount of labor by about 70 per cent. There are constructional advantages in its use and ships can be bunkered at sea much more readily.

Rolling Boilers 21 Miles.—Over a year and a half ago, the passenger steamer "Bear" was wrecked along the coast of northern California and six 45-ton boilers were salvaged from the wreck. It was planned to tow these boilers to Eureka, Cal., but after a number of attempts to do this had failed, it was decided to roll the boilers along the beach for a distance of 21 miles to Humboldt Bay. Each boiler weighed 45 tons, and was 12 feet in length and 13.8 feet in diameter. The work involved clearing a road along the rocky beach. In two places rivers had to be crossed. At the Bear River crossing, the boilers were rolled through a ford, while at the Eel River crossing, they were loaded on a barge and towed for two miles to a point where the rolling process could be continued. When the boilers reached Humboldt Bay, they were loaded on a barge and towed to the wharf in Eureka.

Bearing Power of Piles in Clay Soil.—A recent issue of the London *Engineer* quotes the following from a lecture given before the Society of Engineers: "Clay, containing a definite percentage of water, and at a definite temperature, has a definite pressure of fluidity, and when this pressure is reached and maintained, the clay yields indefinitely as a dense viscous fluid, unless it be restrained from flowing or caused to rise so as to produce a statical head of clay. For equal depths, tapered piles support a larger load per unit volume of the pile than piles having parallel sides, the reason being that as their surfaces keep in more intimate contact with the clay, the friction on their sides is greater. For a given quantity of material of which to make piles a larger number of small piles is more efficient than a smaller number of larger ones. Pointed piles are more efficient per unit volume than blunt ones, because the points cause a more gradual lateral displacement of the clay, thus leaving it in more intimate contact with the sides of the piles. The resistance to penetration is considerably greater the lower the temperature of the clay, probably because the pressure of fluidity increases as the temperature decreases."

Science

Training Field Workers in Eugenics.—Director C. B. Davenport, of the Eugenics Record Office on Long Island, assisted by Dr. H. O. Laughlin, has been giving every summer since 1910 a six-week training course for field workers in eugenics. The course comprises 25 lectures on human heredity and eugenics, with special reference to conduct, together with laboratory work on charting family pedigrees, tracing the descent and recombination of human traits in pedigrees, statistical studies on variation in plants and animals, studies in the elements of biometry, etc. Clinical studies are made at institutions for various types of the socially inadequate, and field trips are made for the purpose of securing family pedigree records at first hand.

Charles Brinkerhoff Richards, scientist and inventor, and connected in a professorial capacity with the Department of Mechanical Engineering at Yale for the past 34 years, died at New Haven on April 20th. Professor Richards, who was in his eighty-sixth year, was one of the last of the old school of technologists who were forced, in the absence of engineering or technical schools, to bridge by their own efforts the gap between the theoretical subjects then offered at the colleges, and the practical arts in which applications of these studies lies; and that no such obstacle as this will keep a great engineer down was amply demonstrated in his case, as in many others. Aside from his long connection with Yale, Professor Richards was, perhaps, best known as the inventor of the steam-engine indicator that bears his name, and that has been termed the most important single factor in the development of the steam engine since the original inventions of Watt. He was also a pioneer in the development of the platform-scale machine for testing the strength of materials, and was responsible for many advances in the field of heating and ventilation.

Sex a Relative Condition.—The elaborate investigations of sex phenomena in various plants and animals made by Dr. A. M. Banta, under the auspices of the Carnegie Institution (Department of Experimental Evolution), lead that biologist to some interesting ideas, which he sets down in a recent report of his department. "We are coming," he says, "to the time when it would seem imperative to revise our ideas of the fixity of sex. With the relativity of sex so emphatically shown in hybrid pigeons, in hybrid moths, and in different species of Cladocera, one wonders if the relativity of sex ends with pigeons, gypsy moths and water fleas. There seems every reason to think that it does not." He cites the phenomena of the "crowing hen" and the "sitting cock," the masculine woman and the effeminate man, as merely conspicuous examples of sex intergrades, which refute the common conception of maleness and femaleness as complete, opposed and mutually exclusive phenomena. Indeed it is a reasonable supposition that sex is always relative; "that while most sexual individuals of whatever species are prevailingly male or prevailingly female, every individual may have something of the other sex intermingled with the prevailing sexual characters."

Some Facts About Infantile Paralysis.—A voluminous work setting forth the results of studies on poliomyelitis (infantile paralysis) in New York City and the northeastern states during the year 1916, by Drs. Lavinder, Freeman and Frost, has been issued in Washington as Public Health Bulletin No. 91. The tentative conclusions reached by the authors are as follows: 1. Poliomyelitis is, in nature, exclusively a human infection, transmitted from person to person without the necessary intervention of a lower animal or insect host; the precise mechanism of transmission and avenues of infection being undetermined. 2. Infection is far more prevalent than is evident from the incidence of clinically recognized cases, since a large majority of the persons infected become "carriers" without clinical manifestations. It is probable that during an epidemic a very considerable proportion of the population become infected, adults as well as children. 3. The unrecognized carriers and perhaps mild abortive cases are the most important agencies in disseminating infection. 4. An epidemic of one to three recognized cases per thousand, or even less, immunizes the general population to such an extent that the epidemic declines spontaneously, owing to the exhaustion or thinning out of infectable material.

Automobile

Combined Horn and Lamp.—Two prominent men in the Eastern automobile trade have invented a combined horn and headlight for automobiles that is said to save material, give adequate protection to the horn and at the same time provides for mounting the horn at a point where it is most effective, or at the front of the car. The construction worked out by the inventors is as follows: Near the rear of a headlight of the usual bullet type, and below the horizontal diameter of the lamp, a hole is made, and the metal edges are turned up and ferruled. This opening is slanted both downward and rearward to prevent rain beating in, or the careless flooding of the lamp by the car washer. The ferrule is provided as the supporting member of the signaling device, as well as the mouth of the horn, as this is the aperture through which the warning sound finds egress. The mechanism of the signalling device may be any of the types now in common use. It is either made integral with or connected to the ferrule, and fits snugly in the rear of the lamp in the space back of the reflector. With the vibrator type of horn, the lamps are not altered except for the making of the one hole, the bulb arrangement is not disturbed, and the wires of the horn are threaded through the tubular member of the lamp and its regular supporting post with the lighting leads. No other wires are required.

Wick Oiling for Chassis Parts.—For some time past, automobile designers have sought to provide some simple form of automatic lubrication system for the usually neglected parts of the car chassis, such as the spring bolts, brake connections, radius rod bolts, spring shackles and other out of the way parts. While oil is not an ideal lubricant for heavily loaded, slow moving bearing surfaces, it has the advantage over grease of being fed by capillary attraction while grease needs pressure to force it to the bearings and if this pressure is not appiled, the grease will not flow. The method employed is to cast or otherwise form oil reservoirs integral with the supporting bearings and to have a wick run from the oil through the hollow bolt or shaft that is to be lubricated. The wick draws up oil constantly which is supplied the bearings by suitable drilled holes in bolt or shaft. Naturally, such a device is automatic in action and as the reservoir may hold enough for several weeks' operation, the motorist is not called upon to give the oiling means frequent attention and the essential lubricating process is not apt to be neglected. As the parts thus oiled automatically are those that wear out and make noise when the car is operated, any system that insures a regular supply of oil and consequent diminution of depreciation is worth while. It is believed that many of the new models will have some such automatic oiling means for chassis parts.

Simple Gage for Measuring Compressions.—One of the most common causes of lost power in an automobile is that the force of the explosion pressure depends upon compression pressure before the gas is ignited. If the compression is 80 pounds, the explosive force acting against the piston top and imparting power to it will be about 400 pounds per square inch. If worn piston rings or leaky valves allow gas to escape when the piston is rising on its compression stroke, the resulting decrease to 50 or 60 pounds means a reduction of explosive pressure to about 300 pounds per square inch. Besides this diminution in pressure, there is a loss due to further leakage through the faulty retaining members. A simple compression pressure indicating gage may be made by taking an old spark plug body, from which the porcelain has been removed and fit in a valve from a discarded inner tube by pouring melted babbit metal or solder in to fill the space between the spark plug shell and the valve. When the metal has set, the valve is found to be firmly imbedded in the soft metal. The spark plug is removed from the cylinder to be tested and the combination plug body and valve stem put in its place. As the engine is turned over briskly by either the hand-crank or self-starter by an assistant, or the engine run slowly on the other cylinders, a tire pressure recording gage held against the valve will record the compression pressure just as it does air pressure inside a tire. If the pressure is low on all cylinders it is a good indication that the entire engine needs attention. You can determine whether the compression is adequate by comparison with the same tests on a new car of the same model.

America's Optical Emancipation

How a Dreamer of 66 Years' Standing Has Seen His Vision Realized

By Hugh A. Smith

UP a steep river road from the flats below trundles a motor truck. It is just an ordinary truck, and its load does not bulk large, but in the industrial life of the factory on the brink of the age-worn gorge it has supplanted the ocean liner and transatlantic freighter. Furthermore, it furnishes daily evidence of the solution of the most difficult crisis confronted in America's urgent wartime industries. For this truck is laden with optical glass, among the most precious and hitherto unattainable of raw materials. When the problem of its manufacture was successfully solved for the first time in America, the culminating chapter was written in the emancipation of the optical industry from Germany.

Until a little more than four years ago optical glass, which differs radically from the commonplace window or even tableware variety, was regarded as one of the exclusive, industrial heritages of a very few European countries, particularly Germany. It was one of those industries, shrouded in mystery, whose secrets are handed down from father to son in restricted communities. Then the war clouds broke in Europe, and of a sudden ships ceased docking at American ports with their cargoes of this foreign product. American ingenuity faced another of those raw material problems which must be solved, if one of the country's most important industries was to be maintained. It was a crisis in that industry which the government was quick to recognize, and keenly so when America entered the war. For without optical glass it could not obtain the range finders, gun sights, periscopes searchlight mirrors, photographic lenses, binoculars and other optical instruments, which it immediately called for; and without those instruments America's army and navy would have been but blinded forces in the practices of modern warfare.

This condition is not one of recent growth. When John J. Bausch came to Rochester, N. Y., in 1853 and, by hanging a few pairs of home-made glasses or spectacles in the small front window of a cobbler's shop, founded what has grown into a great optical business, he was compelled to make his spectacles with lenses imported from the old country. Optics was at that time almost an unknown science in America, and its industrial application even more rare. Popular prejudices decreed that everything optical must come out of Europe. Nevertheless, the lenses which Europe delivered to young Bausch were so unsatisfactory to that exacting mechanic that he constructed the first lens-grinding machine in America and began to grind his own by hand. Some specimens of his superior product attracted the attention of New York opticians, who straightway discovered the source and asked that they be supplied with any surplus lenses which he might turn out. As Mr. Bausch's sons grew up and joined their father, the scope of the business was gradually extended to the various fields of higher optics, contending at every step of the way against the inherited preference for European products. Today practically every type of optical instrument is produced in this American plant, which undoubtedly, since the outbreak of the war, has come to be the largest optical manufactory in the world, not even excepting the wonderful establishments fostered and subsidized in the past by the German government.

During all that development, however, this pioneer establishment was compelled to depend upon Europe for its basic raw material, the optical glass constituting its life-blood. This condition dissatisfied its founder as much as had his earlier dependence upon Germany for eyeglass lenses. The material was satisfactory enough, but the source was too remote and the relationship out of harmony with his other plans and purposes.

The special pottery where pots are made that will satisfy the exacting demands of optical glass manufacture

In the development of his business Mr. Bausch had aimed to control all processes, insofar as possible, having his own foundry, in which were cast metal parts for the different instruments, and his carpenter and cabinet shops, in which all wooden parts and cases were produced. The optics were computed, shaped, ground and polished in his plant, but all from the rough glass blanks originating in Europe. This condition was so galling that often in the presence of his son, William, he declared that he would give all he possessed if he were not compelled to look to Europe for his glass supply. Such statements influenced William Bausch, as early as 1903, to begin some secret experimenting on his own initiative in the little glass-pressing plant which had been erected in the preceding year on the Genesee River flats behind the factory for the purpose of molding the rough blanks before grinding. His first attempt, in one of the small and wholly inadequate pressing furnaces, proved most inauspicious. Seeking a pure, white glass, he obtained a product as green as the most brilliant emerald.

The size of the job he was attacking may be inferred from a brief reference to the history of optical glass manufacture in Germany. In 1876 Professor Abbe, one of the world's foremost optical scientists, stated that the future improvement of the microscope was in the hands of the glassmaker, implying that the optician had gone as far as he could in the development of precision optics with the glass then available. In response to his appeal Dr. Schott, Drs. Carl and Roderich Zeiss and other scientists, subsidized by the Prussian government, worked in their laboratories for five years before they were able to produce, in their new factory at Jena, the better optical glass which they sought.

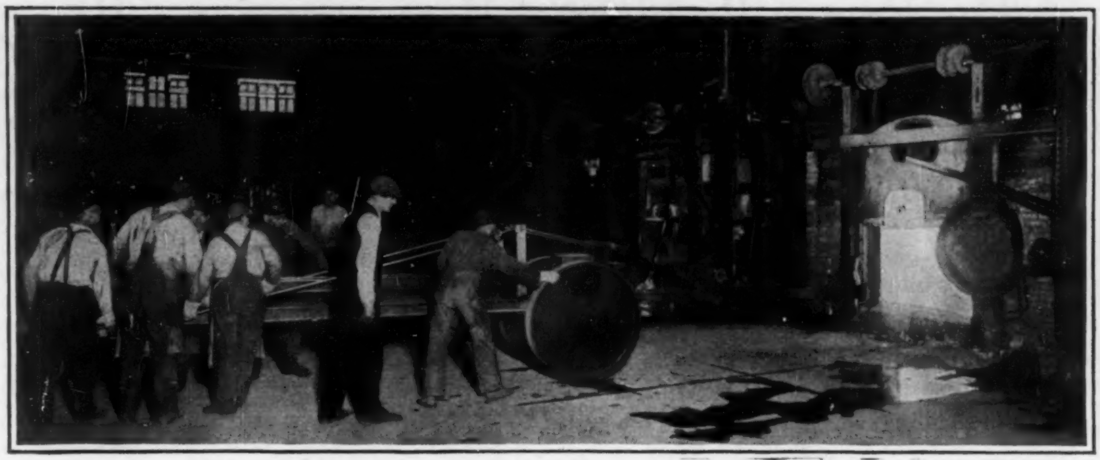
This Jena glass, so-called, is marked by its absolutely clear transmission power and its freedom from all strain and striae, giving it an entirely even refractive index throughout. It is capable of being corrected for both chromatic and spherical aberration, which means that it can be made to transit perfectly accurate and colorless images to the eye, the photographic plate or the screen, as the case may be. It is absolutely essential to the manufacture of optical prisms and achromatic lenses. So exacting and difficult are its requirements that any pot which yields 20 per cent of usable glass after final inspection, is considered very satisfactory. This results, of course, in a high manufacturing cost, the list price of optical glass of the quality indicated ranging, even before wartime advances, from $1 to nearly $20 a pound.

Mr. Bausch's early efforts to accomplish his purpose of producing this glass in America appeared so futile that he practically abandoned the project for a number of years. Finally, in the spring of 1912, he attacked the matter by again entrusting his purchasing agent with the task of obtaining information regarding equipment needed for optical glass manufacture in Rochester. At the same time he advertised in the trade papers for a glassmaker, in the vain hope that a lone member of that ilk, with optical glass experience, might have strayed to these shores. He was unable to find such a definitely trained artisan, but did finally locate a young Belgian, Victor Martin, a glasscutter by trade, whose father had been a glassmaker in Belgium. This Belgian William Bausch engaged at his personal expense and set at work on the river flats. He also put an oil-firing furnace in a small shed adjoining the pressing plant.

A pot of optical glass (right) after cooling for several days; note the clay cylinder of the stirring rod standing in the side of the pot. At the left is shown the same pot in process of being broken up

With that equipment Martin began his experiments. His early efforts were but little more successful than had been those of his employer, and most of the year 1913 he spent in studying what works he could find on the subject, supplementing the knowledge thus acquired by interviews with his father.

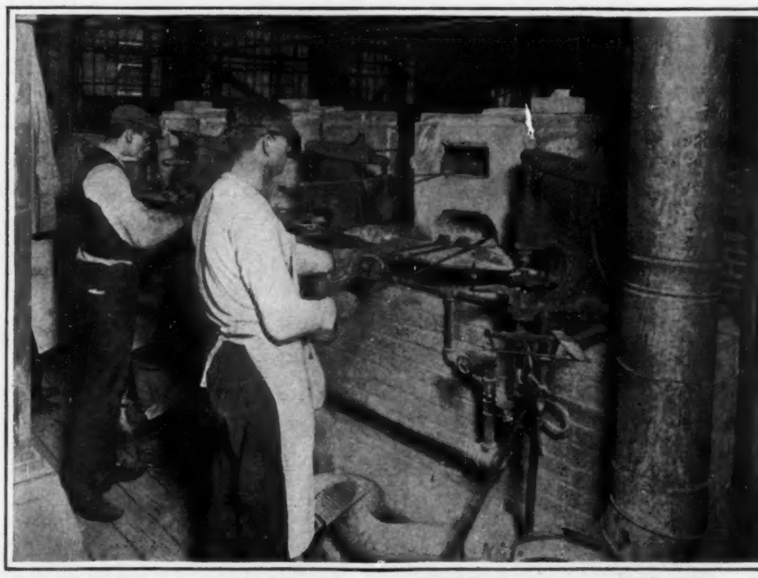
In the spring of 1914 he designed and built another oil-firing furnace but was unable to hold the required temperature with it. The city gas as then applied, proved to be an equally unsatisfactory source of heat; and efforts were practically suspended until after the war started in Europe in the late summer of that year. Then the importation of glass speedily became difficult and uncertain. All of this most important material that the company could count on for its future operations was the surplus stock which it chanced to have in its vaults at the time.



Taking a pot of glass from the furnace. The pot is really almost white hot, but looks dark in the glare from the furnace, whose temperature is about 2600 degrees Fahrenheit

The other members of the company accordingly became definitely interested in the problem, and in the winter of 1914-15 a second building was erected on the river flats, containing two gas-firing furnaces and one pot-arch, or smaller furnace, which is used for the preliminary heating of the pots. The work could now be undertaken on a larger and much more effective scale, for, with the knowledge of theory and formulae already acquired, successful production was largely a matter of persistent experiment and repeated effort. The first melt of barium crown glass, in May, 1915, came out purple and was not usable. In the third melt of the same month, however, some light crown and dense flint glass were produced, which were usable. During the following month light flint was also successfully produced, and experiments were begun on most of the other types in more common use.

Thus after three years of labor, more disheartening than can be indicated here, following several other years of dreams, the victory had been won and another European monopoly, an exceptionally tenacious one, had been broken. No boastful announcements were made, however, as the pioneer producers wished to be absolutely sure of their ground before taking the public into their confidence. In the early summer of 1916 specimens of several different types of optical glass were displayed at the national conventions of the American Medical Association and the American Optical Association, in order to allay the somewhat panicky fears of the trade and profession at large.



Three of the many pressing furnaces in which the small pieces of finished glass are fashioned into approximate form

In the winter of 1916-17 the plant produced glass, which was used in the manufacture of several hundred high-priced anastigmat photographic lenses, hitherto employing only the highest grade Jena glass. These lenses were fitted to speed cameras and subjected to the most exacting tests. In subsequently congratulating the plant on its achievement, the camera manufacturer wrote: "Our critical tests of these lenses show them to be not only equal, but superior to the same type of lenses heretofore made from imported glass."

When America entered the war in April, 1917, one of the first objects of the government's concern was the supply of optical glass. The authorities made a survey of the situation and found that of the several establishments at that time contending with the problem, the plant which William Bausch had fathered in Rochester five years before was the only one actually producing satisfactory glass. The Geophysical Laboratory of the Carnegie Institution, at Washington, D. C., which had been turned over to the government at the outbreak of the war, accordingly established a research laboratory at the Rochester factory, at the suggestion of the Council of National Defense. The Geophysical Laboratory was headed at that time by Arthur L. Day, Ph.D., who detailed Major F. E. Wright, Ph.D., at that time a civilian, to take charge of work at Rochester.

The government laboratory came to Rochester in the spring of 1917 with a staff of six men. The chief difficulty up to that time had been in the low transmission power of the glass produced. The government workers were instrumental in obtaining purer raw materials, with which this difficulty was largely covercome; and it then became simply a case of trying out different methods of stirring and temperature control in order to produce glass of the highest quality.

Meanwhile the glass plant was materially enlarged by the erection of additional plant and buildings, until today it is one of the largest optical glass plants in the world. It employs, when running full force, about 500 hands and contains, besides six single-pot arches, eighteen double-pot arches and one stone arch, five single-pot melting furnaces, three double-pot melting furnaces and one 16-pot melting furnace, with a total capacity of about 416 pots a month. When the plant is operating at full capacity, it consumes more than 33,000,000 feet of gas per month, or an amount equal to the total monthly consumption of a city of 60,000 inhabitants.

Of the different types of optical glass, light crown, boro-silicate crown, barium crown, light flint, dense flint and silicate crown (the last named for ophthalmic lenses) are being produced of a quality equal to any previously obtained from Europe, while experiments on other types are constantly being conducted. The extent to which the production has been placed on a practical and permanent basis is indicated by the fact that, when the armistice was signed, enough finished American glass had been placed in the vaults to last the company several years under normal operating conditions.

Early in the development of this activity difficulty was experienced in obtaining suitable clay pots for melting the glass at the tremendous temperature required. American potteries had never before been called upon to meet such exacting requirements. In using the best pots obtainable, ingredients from the pot would too often mingle with the molten mass and spoil the resulting product. This difficulty was finally overcome by building a pottery alongside the glass plant, engaging a technically trained expert in ceramics and making, on the spot, pots especially designed for their specific uses.

The processes of optical glass manufacture are fascinating and more or less spectacular. The pot, a heavy, cylindrical vessel of superior clay, open at the top and measuring from 26 to 36 inches in diameter according to the requirement, is brought from the storeroom of the pot house and placed in the pot-arch for preliminary heating, which takes four or five days. When it reaches a temperature of about 1,800° F., it is transferred to the melting furnace, which has been heated meanwhile to the same degree, and the temperature of this furnace is brought up to the melting point of from 2,400° to 2,600° F., according to the type of glass to be melted.

Pouring a pot of ophthalmic lens glass on to the casting table, where the big roller will convert it into a smooth, even sheet

Then the raw ingredients, which have been previously mixed according to established formulae, are "filled into" the pot at intervals. The ingredients employed depend upon the kind of glass desired. They are essentially the oxides, carbonates and nitrates of certain metals, of arsenic and borax, etc. A glass containing

(Continued on page 489)

The French Problem of Reconstruction—II

Thirteen Billion Dollars' Worth of Physical Damage

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in France

IT must not be understood that all the destruction war has worked in France is a matter of stone, building, houses, barns. It isn't. It's a destruction of everything, even of the land, of which more in a moment. Take the matter of public works in general and railroads in particular. Two billion dollars is the estimated public works bill of damages, of which $200,000,000 is for the Nord railroad, which lost 1,731 bridges and 338 stations, not to mention the destroyed right of way.

There were $200,000,000 worth of canals destroyed; the Est railroad needs $150,000,000 worth of repairs and replacements and other roads at least $50,000,000. As far back as 1917 they counted over 435 town halls destroyed, 600 schools, 472 churches (the Boche was especially fond of shelling churches). Today the totals undoubtedly reach in excess of 1,200 churches totally destroyed and over 1,500 schools gone beyond anything short of rebuilding.

Over one thousand industrial plants have been razed to the ground. This is a more serious matter than merely destroying the buildings, for an industrial plant has machinery, models, patterns, jigs and plans, all of which must be duplicated after the buildings are duplicated before the industry can resume, and then the economic reconstruction problem will come to the fore—getting the old customers back, getting new trade outlets, etc.

It may be of interest to attempt to visualize some good-sized figures of the amounts of building materials which have been blown to pieces. The figures, of course, are approximate, and based on the known destruction of buildings, compared with a more careful and elaborate census of destruction made in certain districts a year ago. But the figures are probably under rather than over.

These figures include 8,500,000 cubic yards of stone masonry, 3,000,000 cubic yards of brick masonry, 1,500,000 tons of lime, 600,000,000 feet of lumber, 100,000 tons of iron and steel, 4,500,000 roof tiles and 160,000,000 roof slates!

And all this building material surrounded, in the form of houses, furniture and personal belongings which even a conservative insurance company values at $1,000,000,000 and the government at $2,025,000,000!

Reference was made a moment ago to the damage to land. It is at first glance not easy to see how earth is to be damaged. But consider the most superficial damage of all; the putting in place of barbed wire entanglements. One thinks, at home, of barb wire as a little fence set up between trenches, in "No Man's Land." Then one comes over here and sees the fact; miles and miles, endless miles of barbed wire, not in orderly fences, but in twisted masses, and these miles and miles are not only in length, but in depth. Behind the Verdun battlefields where the German Fifth Army was stationed for so long, there is enough barbed wire in position to require another six months' bombardment to remove!

Chateau Thierry after the Germans had retreated, July 27, 1918

There can be no tilling of the soil until it is removed—a long, slow, tedious process, involving the expenditure of millions in labor to cut, to drag to barbed wire graves—or else the expenditure of precious years waiting for nature and rust to remove this hideous wart on a fair land. One places barbed wire from orderly rolls, quickly, easily. One displaces it by blowing it to bits or by difficult hand labor during peace, and the barbed wire damage is the *least* which has been done to the land.

The barbed wire problem may have some unexpected solutions. Tanks have been used to drag it from the land with great success. Indeed in more than one American action, tanks hooked into barbed wire entanglements and literally pulled it from the earth for a quarter of a mile to let troops go through.

It should not take a very great amount of ingenuity to produce a machine with heavy rollers not, perhaps, dissimilar to a rock crusher into which this mass of wire and piles might be fed, and which would turn out at the other end an endless rod of wire and crushed wood of varying diameter according to the amount of wire. This tangled mass, compacted by the machine, could be chopped into lengths and those lengths used for reinforcements in poured concrete work. The suggestion put forward to the writer by a soldier engineer, may be but one of dozens, any one of which might aid in the barbed wire problem. But whatever method is used it must be a new and an ingenious one, and it will take money and machinery and initiative. Whether France has any to spare for this, or whether she will use hand labor and allow time to be a factor, she has not said and certainly the present scribe will not attempt to say for her.

The great damage to land has come from intensive shell fire. A shell which explodes beneath the surface of land churns it up, buries the top soil, and brings earth to the top which will not grow even a weed. The mere physical disturbance of the land, the making of a tillable field into a series of hillocks and holes is bad enough; but even if leveled off, such fields are still worthless, since years must elapse before the soil again becomes fit to grow crops. Of 8,000 square miles in German hands in May of last year 6,000 square miles were tillable for crops and most of the rest fit for hay and pasturage. It represents some of the finest agricultural land in all of beautiful France. Ten invaded departments in 1913 produced $400,000,000 in crops. These regions are perhaps 15 per cent of the tillable area of France and produce 20 per cent of her crops, supporting 800,000 people or 10 per cent of the working agricultural population of France. All this, of course, is history. The land is idle now and will be for some time to come, and a quarter of a million acres of it will not be cultivated again for many, many years, unless science finds a way of turning bottom soil to top!

There are thousands of sad miles of destroyed woods. One wanders through the Argonne forest, or what was the forest, once, and catches one's breath at what the Americans did there. But one realizes too, at what a cost to France. The Argonne forest is a name. The trees are but stumps. Shell fire does to a wood that which must be seen to be understood. A western forest fire is far less disastrous, since it, at least, does nothing to the land.

Think of 250,000 little farms, all idle! Think of $800,000,000 of farm land, unproductive. Think of the agricultural instruments, destroyed and stolen, which must be replaced: 50,000 side hill ploughs, 33,000 other ploughs, 56,000 cultivators, 30,000 mowing machines, 115,000 farm wagons, 88,000 harrows, 50,000 rollers, 50,000 hoes, 36,000 seed drills, 13,000 fertilizer spreaders, 16,000 beet extractors, 21,000 winnowing machines, 18,000 horse rakes, 32,000 reapers and binders, 53,000 root cutters, etc.

Cattle have diminished in these regions by over 50 per cent. The loss in wheat is 1,300,000 acres, in hay, 850,000 acres, in beets (sugar), 380,000 acres. Altogether, soil, livestock, crops, forests, tools, land, the damage bill runs over $2,000,000,000, which it is true Germany may pay, but Germany can never pay for the time required for the physical rehabilitation.

No possible estimate can be made of the damage to French industry which will cover the case. Estimating in dollars is much like estimating in dollars for human life destroyed. The wife who receives $10,000 insurance when her husband dies has a fence raised between her and poverty, but does she consider herself paid! Germany may pay to the last dollar for the damage done to French industry, but can any payment ever compensate for the time, the product, the effort wasted?

But again one confronts figures and dollars as the only available pigments with which to sketch the ruin. So one starts with 200,000,000 of dollars destroyed in the coal regions, and tries to understand what it means when it is said that 70 per cent of France's best coal, produced in her own lands, came from the invaded regions and that 140,000 Frenchmen worked in coal fields which were for years in German hands. Three quarters of a million people depended on the coal mines for a living, and while France has her mines again, getting them under production once more and rehousing the miners and their families is a task which may take years.

Half a billion dollars' worth of machinery in iron and steel mills are destroyed or taken into Germany. One hundred and twenty millions of damage was done the textile industry. There were 210 sugar refineries in France in 1914. Now there are 70. Is it any wonder that the saccharine bottle is a commonplace in the French restaurant, the sugar bowl an unknown dish? Of 3,000 brush factories two-thirds are demolished. Fifty millions in electric power stations are gone, producing 300,000 k. w., and that power is needed now. Breweries have lost $25,000,000, $100,000,000 in small machine shops has been ravaged to fill Hun factories or wantonly or otherwise destroyed. Sixty millions may and may not cover the foundries loss, and none of these figures cover land or buildings. Moreover, machinery is three times as expensive today as it was four years ago. France calls her machinery bill for destroyed or stolen engines of industry $4,000,000,000.

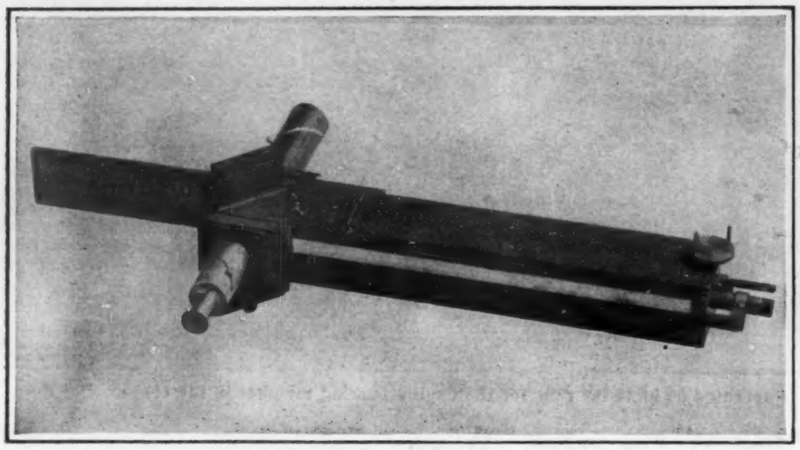
And so one might run on for pages. Twelve hundred thousands acres of forest destroyed. Output of cement, now badly needed, reduced from 3,000,000 to 400,000 tons a year. Ten per cent of her lumber, 6½ per cent of her firewood are gone. One wanders through a sea of statistics and wonders which is the ruddiest in color, the most flaming in horror. One statistician with an imagination has calculated that if France could put 500,000 building tradespeople to work, and for 20 years they did nothing but rebuild and repair the damage of war without starting a single new project, France might look, in 1939, as she did in 1914!

The total physical damage is estimated as some $13,000,000,000. The human mind does not comprehend 1,000,000,000 save as a name. One cannot adequately realize 1,000,000 let alone 13,000,000,000!

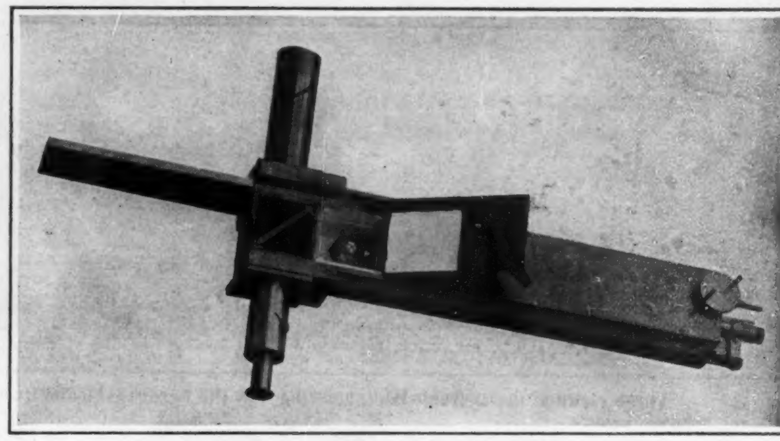
This, then is the problem, purely the physical aspect of the problem, which France faces. That she must still maintain her army, look after her army of occupation, conduct her business and her government, take care of her wounded and her refugees, find work for her helpless and at the same time manage her end of world affairs makes her situation unenviable, to say the least. She has tackled her job with the same high courage which made the bluecoated soldiers invincible at Verdun. One looks in vain for any expression of discouragement, of fear, of anxiety.

The Hun is out of France. The future is before her. The great fact of the present is that the war is over and that, be the problem of the days to come what it may in difficulty, it cannot possibly be so bad as that of the years when no man knew whether peace would come with victory, or with annihilation—it was never thought by any that it could come with defeat.

Inadequate as this picture of destruction is, it must serve, for lack of a more able pen, as a background for the story of what France is doing to get back. In further papers to be published, it is hoped to show how France is working on her problem, and that America is aiding her, both in much needed material help, and in an industrial and scientific working revelation which cannot but have a great effect in speeding up the rebuilding of this sadly stricken land.



The visibility meter ready for action



Visibility meter open to show its working parts

Increasing Visibility Through a Knowledge of Camouflage

Suggestion of Permanent Peace-Time Value Drawn from the Efforts to Make Ships Invisible

By Robert G. Skerrett

IT may be said without fear of contradiction that we have shifted marine camouflage from the field of a debatable art to the realm of science. In doing this we have settled a number of vexing questions, and we have achieved results that are likely to be of the highest value in the days of peace. This may sound paradoxical, but it is only proof that principles, when thoroughly understood, are susceptible of application in radically different services.

The public has already been told of some of the results obtained by us in seeking to develop systems of protective coloring for our shipping-systems that would either induce a notable degree of low visibility at gunfire ranges or mislead the man at the periscope through the effect of "dazzle" or confusion. After we had been some months at war with Germany we were still groping in our efforts to evolve a really satisfactory order of marine camouflage. The constituted Federal authorities actually approved five more or less radically dissimilar systems—the products of five New York artists who had tackled the problem from as many different angles. In a very large measure their essays were essentially empirical, and each was pardonably certain that his was the correct solution.

We should probably have gone on guessing, just as our Allies abroad did throughout the war in this department of deception, had the question not been attacked by the Submarine Defense Association and, through it, analyzed and investigated in an exhaustively technical manner. The Submarine Defense Association was called into being by something like a hundred steamship companies, marine underwriters, and others interested in nautical matters, and its primary object was to devise ways and means for either dodging the U-boat or minimizing the effectiveness of its offensive weapons. Naturally, marine camouflage was one of these, and the association realized that the selection of the protective coloring that would answer best could not be left to personal opinion. It was perfectly plain that some scientific basis of comparison had to be established and agencies developed, where none existed, that would evaluate with precision the relative merits of rival camouflage designs or methods. To put it popularly, the competing camoufleurs were all from Missouri, and, what is more to the point, it was necessary to make them see the fruits of their own labors and of others with unbiased eyes. How was this done?

Mr. Lindon W. Bates, chairman of the Engineering Committee of the Submarine Defense Association, secured the coöperation of a large camera concern, which placed at the disposal of the Association its magnificent laboratory and the services of its eminent experts in light, color and optics. The whole story of what followed is a fascinating one, but cannot be told now. The matter of immediate interest is an instrument, invented and perfected by Lloyd A. Jones of this company, which made it possible to devise camouflage patterns and to select those colors which would fulfill best the requirements imposed by the light conditions generally prevailing in the North Atlantic and the Mediterranean frequented by hostile submarines. The apparatus in question is the visibility meter, a unique instrument of enduring value.

The readers of the SCIENTIFIC AMERICAN are probably aware of the circumstances under which marine camouflage is employed: they no doubt know the limitations imposed by the low-lying curtain of the sky. That is, they realize that a vessel painted white, gray or black will stand out in vivid contrast against a luminous sky background, but that a ship moving away from the source of light and toward the opposite part of the horizon becomes varyingly visible not by reason of the background, but because of the amount of light which its surfaces reflect and the intensity of the shadows cast by its various features. Therefore, the aim of the camoufleur is to reduce this reflection value and to promote an appearance of flatness by brightening up the shaded areas through the employment of white, light blues and grays. It is a matter of knowledge among technicists that areas of pink, violet and green will melt into a uniform gray at a suitable distance, and that this gray will be either warm or cold according to the predominance of the pink or the two opposing colors, violet and green. On the other hand, a gray can be produced by a similar merging of areas of white, blue and gray with portions of black. These suitably varied in their proportions, yield grays of low visibility admirably suited to the conditions imposed by a marine setting.

The man in the street will probably want to know just how the scientists of the Submarine Defense Association chose the coatings finally adopted—Omega gray and Psi gray. In observing the sky grays characteristic of the two sections into which they divided the submarine danger zone, it was noticed that the glasses or periscopes employed for this purpose showed prismatic colors around their outer edges, *i. e.*, the well known "corona effect." These, when analyzed by a spectroscope, revealed the color components of the grays, and thus certain blues and whites were found to be essential. With this data to work upon, it was but a matter of patient experimenting to discover just how these colors could be laid on in bands, checkered patterns, etc., to give the desired deceptive qualities at a thousand yards or so and to melt away into a low-visibility gray at 3,000 yards. And now, for the instrument devised by Mr. Jones by which all camouflaged models were measured and ultimately accepted or rejected.

Model	Type	Weather Coefficient	Degree of Visibility
F 20	Light Gray	.43	0.3
F 9	Light Gray	.42	0.6
Louis Herzog	Low-visibility dazzle	.43	4.7
W. A. Mackay	Low-visibility dazzle	.42	4.4
M. Toch	Low-visibility dazzle	.42	6.0
Pleuthner	Dazzle	.43	7.2
E. L. Warner	Dazzle	.42	7.2
Gomez	Low visibility	.43	7.5
G. Brush	Low visibility	.43	7.5
W. A. Mackay	Low visibility	.42	8.2
Patterson-Sargent	Dazzle	.43	9.5
Sherwin-Williams	Low visibility	.43	10.0
British	Dazzle	.42	14.0
F 6	Black	.42	24.0

Visibility of models tested by the Submarine Defense Association

Floating particles in the air catch and scatter light; and depending upon the prevalence of these particles we have a so-called clear atmosphere or a condition of luminous haze. If this haze or veil be bright enough it will shut out from view an illumined object lying back of it. This condition is very common at sea, and an observer will frequently fail to discover land or a passing ship hidden by an intervening screen of this character. It is just this phenomenon that Mr. Jones has used as the basis for his visibility meter, in order to gauge the light-reflecting character of a camouflaged model. He purposely creates a diffused light or luminous veil between the eye of the observer and the model to be measured, and when this screen is strong enough to obliterate the image of the miniature ship a register indicates the actual visibility of the obscured model.

The visibility meter has the outward appearance of a telescope projecting through a supporting rectangular case of some length. In this case is a small electric bulb which can be moved vertically through a considerable distance, and the position of the lamp is indicated by an index hand passing over a graduated scale. The light from the bulb passes up through opal glass and is reflected by a mirror set at an angle of 45 degrees in the axis of sight of the telescope back to the eye of the observer. The mirror is a semi-circular disk which covers the lower half of the field of the instrument, or, in other words, shuts out the water area up to the horizon line. The light issuing through the opal glass is of a soft or diffused character, and its intensity is determined entirely by the vertical position of the incandescent bulk in relation to the mirror.

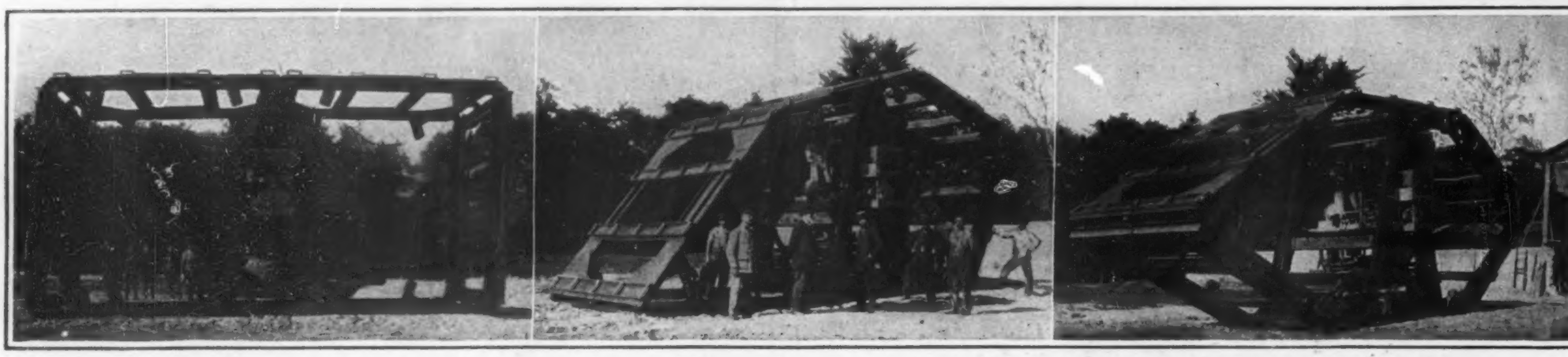
As the lamp is shifted up and down there is moved in unison with it a wedge-shaped member of neutral gray glass which tempers the brightness of the light coming from the natural sky or the background behind the model, and reduces proportionately the apparent vividness of both the background and the camouflaged image. This makes it possible to employ successfully a lamp of modest candlepower for the production of the veiling glare. When this glare is of sufficient strength to shut out the object or to make it seem to merge with the background, then the reading of the instrument gives a true measure of the visibility of the model when viewed normally in the prevailing light conditions.

A careful analysis of weather reports covering the region in which the majority of the ships were sunk by submarines revealed that 70 per cent of the days were cloudy, and from this data the scientists of the Submarine Defense Association determined upon a reflecting power of .43 as a weather factor that had generally to be considered in meeting the requirements of low visibility. This point is of interest because it bears directly upon the relative merits of the products of artist-camoufleurs and the colors and system settled upon by the scientists of the Association. The accompanying table is based on analyses of competing designs which were tested by the visibility meter. Models F 20 and F 9 were prepared by the Association, and Model F 6 was introduced to show the extreme degree of visibility obtained through the employment of a uniform coat of black.

Invisibility is represented by zero; and the visibility of the various models was rated as if they were viewed at a distance of 6,000 yards. Omega gray, developed for the northern danger zone, has even a lower visibility than that indicated by Models F 9 and F 20. The U. S. S. "Gem," which was used by the Association for experimental purposes, showed a visibility as low as 0.2 in clear weather at 1,500 yards and was invisible at a range of 3,000 yards.

The layman will probably ask: Of what possible peacetime use is all of this scientific work and research

(*Continued on page 471*)



Three views of the Boirault tank, showing how the hexagonal framework is operated so as to lay rails for the engine-bearing member in the center

The Invention That Won the War

How the Tank Idea Was Conceived and Progressively Worked Out

THIS is a story of a wonderful idea which was progressively worked out until it became the leading invention produced by the war. Indeed, while this division and that brigade of one army or another have been seeking all the credit for the winning of the great war, the leading authorities and students of the struggle have at last set aside these immodest claims by stating in clear, unmistakable language that this great Allied invention—the tank—was the decisive factor in the final smashing of the skilfully intrenched Germans.

The tank idea originated at the very beginning of the war, back in those dark days of 1914, when the Germans swept over France and Belgium, met defeat at the Marne, and rolled back some distance only to intrench themselves behind continuous belts of barbed wire. Then the British and French tried to break through the barbed wire and the German trench system, and were only successful here and there on a small scale and at a tremendous cost in blood and treasure. The Germans realized the defensive value of barbed wire backed up by machine-gun and rifle fire. In fact, they halted millions of strong, well-trained Russians who rolled on up to the barbed wire defenses in the east, only to be slaughtered by the tens of thousands. Obviously, weight of numbers counted for little in the face of such defenses.

Then the inventors set to work to find some way of getting at the German machine gunners behind their barbed wire belts. While intense shell-fire served to cut up the barbed wire, it was a crude measure at best. Days of bombardment were necessary before a dense defense could be reduced, and by that time the enemy had ample opportunity to make such dispositions as he thought necessary to meet the impending attack. Obviously, some quicker and more efficient method was necessary—some method that would retain the vitally important element of surprise for an impending attack.

In November, 1914, a French inventor, J. L. Breton, forwarded a plan to the French Minister of War, covering an armored automobile engine driving a circular saw for cutting through barbed wires and their supports. The Commission for Inventions immediately appreciated the military possibilities of this idea, and encouraged the inventor to go ahead with a model. In January, 1915, experiments were carried on with the type of machine shown in one of the accompanying illustrations, consisting of a six-horse-power gasoline engine driving a circular saw held at the extremity of a pivoted arm which could be adjusted so as to bring the saw to bear at any angle or height. While the experimental machine was mounted on a simple factory truck, the actual military machine would have been mounted on an armored car driven by the same or a separate engine. But the inventor and military authorities soon came to the conclusion that the embryo tank would have to be more powerful, and in casting about for a suitable vehicle they came upon the familiar agricultural tractor, with continuous caterpillar belts.

By an ingenious arrangement of track sections and steel cable, inventors sought to span trenches with ordinary motor trucks

At that time, however, it was impossible to secure an agricultural tractor, although M. Breton and Major Boissin, of the technical section of the French engineers, realized that an American tractor was the ideal mount. So it was finally with a Bajac tractor, placed at their disposal by the end of February, 1915, that the experimenters conducted their tests. Mounted at the rear of the Bajac tractor was a powerful set of shears, designed by M. Pretot, as well as a horizontal circular saw intended to saw the wooden supports of the barbed wire a few inches above the ground. Obviously, the tractor was operated backwards in order to bring its cutting members into action. The shears worked fairly well, but the saw performed somewhat irregularly and was subsequently abandoned in favor of a moldboard arrangement similar to that in some present-day tanks. This arrangement gave excellent results when the tractor, which weighed about four tons, was weighted down with another ton to represent the weight of protective armor. After a very successful official test on July 22d, 1915, the French Minister of War decided on the construction of six tanks of this kind. And it was the construction of these six tanks which caused the French army to order the first 10 caterpillar tanks of the Schneider-Creusot type, on December 7th, 1915.

Meanwhile other French inventors were at work, notably Messrs. Turmol, Frot, and Lafly, who followed out the idea of utilizing the usual road roller for the flattening out of barbed wire entanglements. The technical section of the Engineers of the French army conducted a series of experiments with a road roller equipped with a 20-horse-power gasoline engine. This tank, provided with an armored body somewhat similar to later-day tanks, was some 22 feet long, 7 feet wide, and 7 feet high, weighing about 10 tons. It was armed with

All photos courtesy "L'Illustration"

First French device for getting through barbed wire, consisting of a six-horse-power engine driving a circular saw

Barbed wire cutting member of the Breton-Pretot machine, with the horizontal circular saw below the frame

three machine guns and was intended for a crew of eight men—two mechanics, a commander, and six fighters. When it came to getting over the battlefield and through barbed wire, the tank was not a success. In the first place, it could not operate over rough ground and over terrain which happened to be boggy; secondly, it only crushed down the barbed wire which, after the passing of the tank, again rose in place to impede the infantry waves.

Another interesting ancestor of the tank was the machine of M. Boirault, which was examined by the French army authorities during the latter part of 1914. Essentially M. Boirault's tank, which is shown in one of the accompanying groups of illustrations, consisted of an iron structure carrying an 80-horse-power gasoline engine. The power plant, through a set of endless chains, served to drive a set of pinions which in turn operated the power-carrying member along the track laid down by the hexagonal framework. Thus each articulated section of the hexagonal framework was laid down in its proper turn on the ground, and the power-bearing unit rolled along on the short sections of track, just as the caterpillar tank lays down a continuous track for the body of the machine. Barbed wire entanglements and shell holes and trenches were found to be readily spanned by this novel contrivance, which measured about 14 feet in height, 28 feet in length, and weighed about 30 tons. It had a speed of about two miles an hour.

In a series of experiments this novel tank proved quite practical for getting across battlefields; but it failed of acceptance because it could not be steered on its course. This objection was overcome by applying a screw jack, so that one side could be raised free of the ground so as to apply the driving power on the other side. Still, this procedure required too much time; and again, the tank was difficult to arm and still more difficult to protect with armor.

The technical section of the French Engineers then proceeded with the arming and armoring of agricultural tractors of the Filtz type, which were equipped with an inclined cutting member for hacking a way through barbed wire. Driven by a 45-horse-power engine, these tanks were capable of 7 to 9 miles an hour in either direction. In all, 10 such tanks were constructed, each armed with a single machine gun. Against taut wire, these tanks functioned pretty well; but when it came to slack wire they were of little value. During August, 1915, they were sent to the 4th and 10th French armies for use against the enemy. On being tried near the battlefield, however, they proved unable to cover the rough terrain and were returned to the rear before the enemy ever saw them.

Still another attempt at the sudden destruction of barbed wire was the electric torpedo of Messrs. Gabet and Aubriot, which was intended for the transportation of some 200 to 400 pounds of high explosive to some suitable point in the enemy's barbed wire, which could then be blasted at the desired moment. For a mount, these inventors made use of a vehicle with triple caterpillar belts, driven by an electric motor. Power for the electric motor was conveyed through a special cable which was automatically laid as the diminutive tank traversed the battlefield.

In November, 1915, M. Gabet constructed an armored electric tank carrying either a machine gun or a 1½-inch quick firer, with a crew of two men. The electric power was supplied through a cable.

Inventors are prolific people, and never was this better illustrated than in the carrying out of the tank idea. Thus the inventors turned to other means of crossing the chaotic terrain of battlefields, this time using ordinary motor trucks. It was the automobile firm of Delaunay-Belleville which got up the ingenious arrangement shown

(Continued on page 471)

How Long the Oil Will Last

As an interesting sequel to the recent discussion of the probable duration of the coal supply for the world as a whole and for certain countries individually, we present this week a series of graphical comparisons got up by our British contemporary, the *Illustrated London News*, with regard to the oil situation. There has been wholesale discussion of this matter, and the opinions expressed have varied widely—the particular period assigned to the world's petroleum supply by any one authority being ordinarily a function of the faith placed by that authority in shale oil. The rôle which shale oil is to play must of course eventually be a considerable one; but just how considerable, and just how eventually, no no one today can very well say. Accordingly the artist who drew the pictures which we reproduce appears to have been under instructions to ignore it altogether, and to make his pictures talk about natural oil from wells

The source, extent, and probable duration of the world's annual petroleum supply, as pictured by the Illustrated London News

exclusively; the period allowed for the complete exhaustion of the American supply is just about equal to that ordinarily cited for the probable life of our oil wells.

If the United States has oil wells to last 30 years, it is confessed that the corresponding figure for the entire world is an unknown quantity. On a basis of previous performance, it would appear that the world's supply cannot last appreciably longer than that of the United States, since it is clear from another section of the diagram that we are at present producing something like 71 per cent of all the oil that is taken out of the earth. Yet the Mexican production and the possibility of heretofore undeveloped fields are such complete enigmas that no values can be placed upon them; and we have even heard the suggestion seriously advanced that the League of Nations would work so well that a vast fleet of oil-burning war craft could be permanently retired from service, to the everlasting benefit of the oil supply and the commercial user thereof. So it seems eminently reasonable that the compiler of these figures has represented by means of a large question mark the length of time during which the world will still have oil to burn.

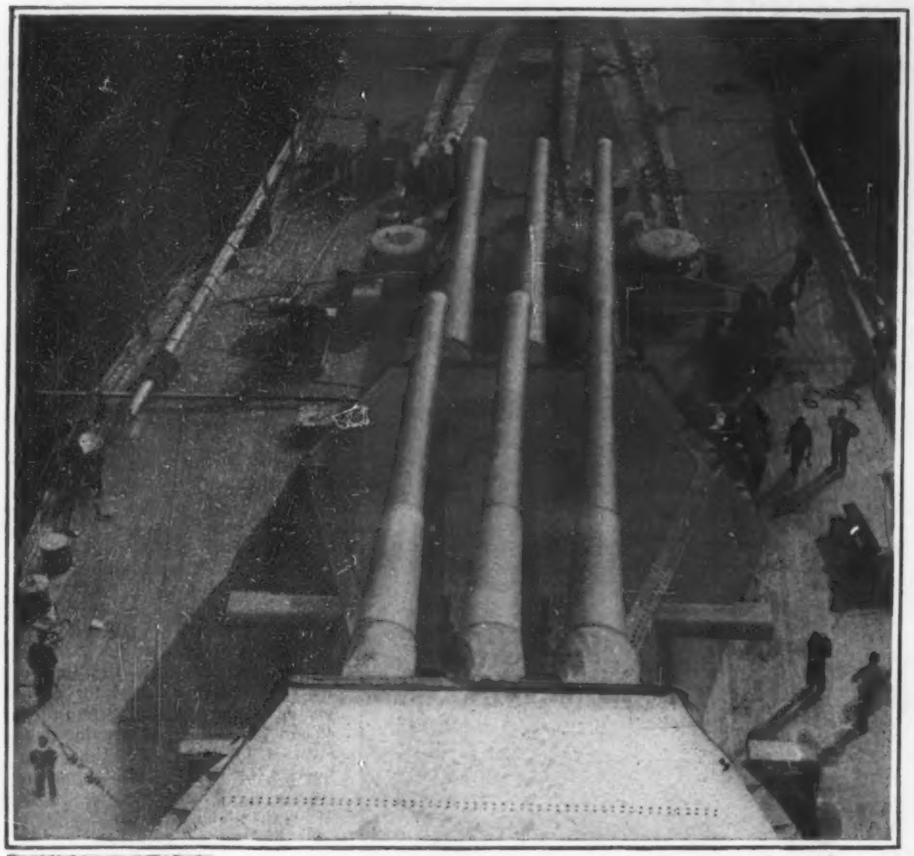
We cannot help commenting unfavorably upon the period which has been assigned, by way of comparison, to the American coal industry. As we pointed out in our recent discussion of coal, the figure 4,000 is indeed the quotient of visible resources by present annual consumption. But our consumption tends to increase with decided rapidity, and our resources are stationary save as we deplete them by use. Indeed, the exact relation between visible resources and commercially available resources is still a very open question. Can we afford to use pretty much all the coal that the Geological Survey tells us the ground contains, or can we bring to the surface only a small fraction thereof at prices within the reach of the manufacturer and the householder? On this point we find a conflict of authorities—and a conflict so sharp that while one person who ought to know what he is talking about suggests 1,500 years as the period during which we shall be financially competent to burn coal, another gentleman of equal standing insists that during the life of the present generation of adults our coal will give out, so far as using it is concerned. But in any event we shall not have coal for 4,000 years, unless engineering triumphs as yet undreamed of provide substitutes for much of that now burned, or ways of stretching the supply out to an amazing degree of longness and thinness.

If the United States is the world's greatest producer of solid fuel, it holds the same position with regard to the liquid combustible. But where China has coal resources which, if developable and developed, will make ours look like a plugged nickel, this does not appear to be the case with oil—as regards either China or any other region of the world. We are the present big producers, and as far as can be foreseen we are the big producers of whatever of future the petroleum industry may be destined to enjoy.

To any question which may be asked bearing upon the reason why this mineral seems on the verge of exhaustion, a ready answer is offered by the course of past consumption and the extent to which it has depleted the petroleum resources. Starting from infinitesimal proportions in 1857, oil production and consumption grew like a huge snowball—grew in a way to throw the compound interest law completely in the shade, so far as any such beggarly rate as six per cent is concerned. Of course, when we start from nothing, or from next to nothing, to build up a thriving business, we expect to see colossal rates of increase, because something is bound to be a large percentage of nothing; so we need not be startled when we note that from 1860 to 1870 the petroleum consumption increased about 1,100 per cent, and from 1870 to 1880 about 500 per cent. But by such increases the industry was placed on a very substantial basis; so it does afford food for thought when we are told that during every decade from 1880 to 1910 the annual consumption of liquid fuel was at least doubled—so that in 1910 it was more than eight times what it was in 1880. And since 1910 it has increased about in the same ratio, so that its normal course seems to be represented by a doubling every 10 years.

What this means to the consumer is obvious enough. Are we going to have eight times as much oil to burn in 1950 as in 1920? Emphatically we are not. We should be singularly fort te if it turned out that we were to have, at that date, 17,000,000,000 gallons to burn on the same scale as in 1917. This is where the pinch comes. If consumption were the same from year

(Continued on page 474)



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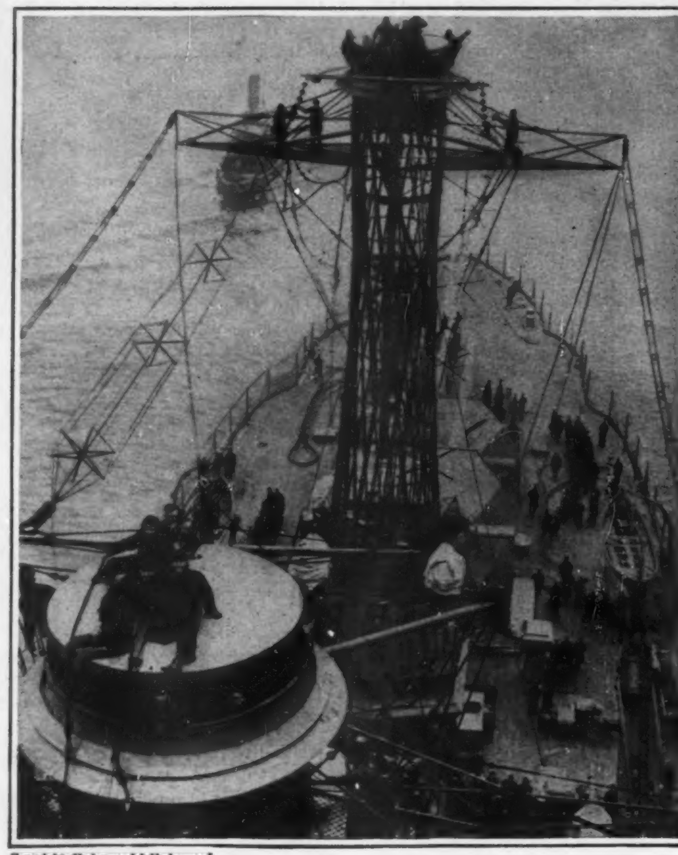
The "Idaho", our latest 32,000-ton dreadnought, showing forward turrets, each mounting three 14-inch guns



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Looking down on the fire-control platforms of the "Idaho" from the Brooklyn Bridge

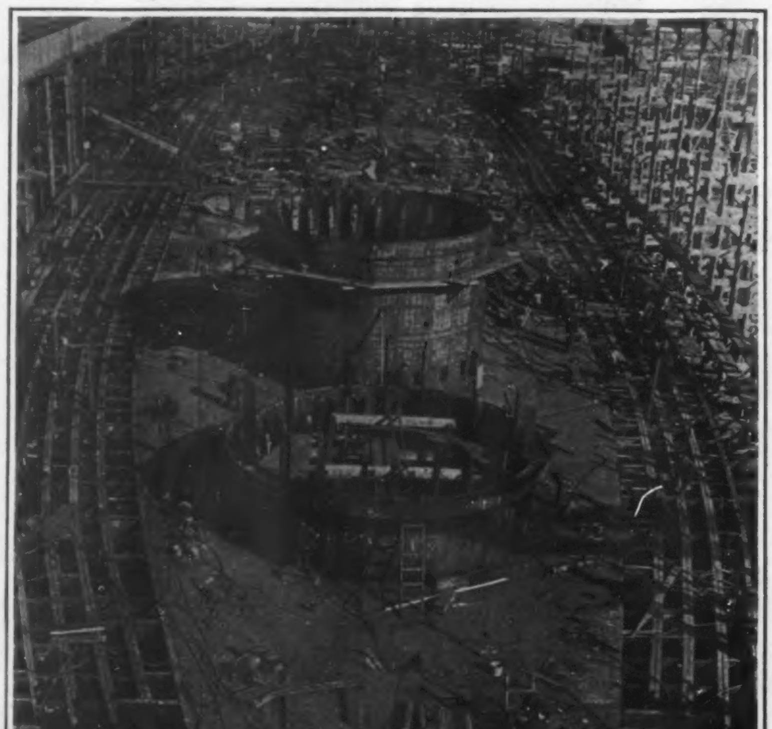
Our Latest Dreadnought "Idaho"

One of Five U. S. Ships Which Are the Most Completely Protected Warships Afloat

WITH the completion of the dreadnought "Idaho," sister ship to the "New Mexico" and "Missisippi," our battle fleet includes five great ships, the largest battleships afloat, all of which carry a battery of 12 14-inch 50-caliber guns and a torpedo battery of 22 5-inch 50-caliber guns. Certain elements in these fine ships will appeal more strongly than others to those who study their design; but to our thinking, viewed in the light of the various capital-ship engagements of the late war, the finest thing about these vessels is their most excellent underwater protection against torpedo attack. A ship which is not thus protected is liable to be sunk by the first torpedo that gets home, or the first mine that she runs over—as witness the loss by mine of the "Audacious" and the many losses by torpedo among the pre-dreadnoughts of the British and French fleets.

The remarkable character of the underwater protection of these ships is shown very clearly in our photograph taken from a point above the main deck of the "Maryland," which is now under construction at the Newport News shipyard. It will be seen that, between the outer skin of the ship and the inner wall enclosing the engine and boiler rooms, magazines, etc., there are no less than four longitudinal walls, intersecting the numerous transverse bulkheads and subordinate transverse partitions. Thus, there is provided, a broad belt, 12 to 15 feet in width, of cellular water-tight compartments. The force of the detonation of a torpedo would be expended in rupturing the tough steel of this construction, and its tearing and bursting energy would be so far absorbed that, by the time it reached the inner wall, it would fail to get through. The Germans adopted this construction in their ships to such good effect that when the battle-cruiser "Goeben" was taken over after the armistice, it was found that though she had been torpedoed or mined no less than five times, and although the innermost walls protecting the engine and boiler rooms were bulged inward, they had held. Similarly, although at least four of the German battleships were torpedoed at Jutland, they all succeeded in getting back to port for repairs.

The "Idaho" is 624 feet in length, 97½ feet broad, has a maximum draft of 31 feet, a normal displacement of 32,000 tons and a full-load displacement of 33,000 tons. Her belt armor is 14 inches thick and in decreasing thickness is carried up to the main deck. She has 18 inches on the port plate of her three-gun turrets, and 16 inches on the conning tower. She is driven by Parsons turbines operating on four shafts, with geared turbines for cruising. Her speed at full power is 21 knots. The boilers are oil fired and the ship can stow in her double bottom over 3,000 tons of oil fuel.



Copyright, International Film Service

Deck view of the 32,300-ton "Maryland" shows the wide anti-torpedo, cellular construction, which will enable her to survive the blows of several torpedoes

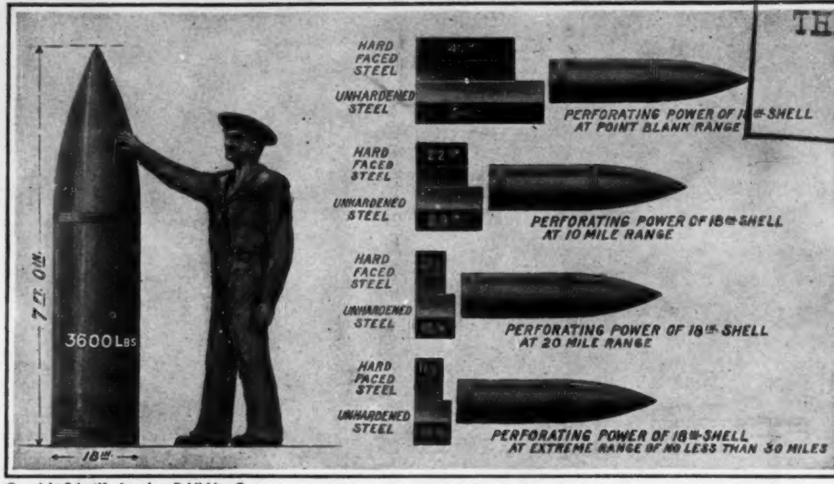
Homing Pigeons for Forest Fire Protection

THE State of Minnesota and the Canadian government have adopted the system of Homing Pigeon Communication devised by Philip E. Edelman, E.E., for Forest Fire Protection. This system provides reliable communication under conditions impossible to wire and wireless methods in wild countries. In a given area, a home nest is established at headquarters. The men in going on patrol carry two birds in a special carrier on their back, or kit, or in their canoe. If emergency arises they can instantly call for help by releasing one bird with message, and 10 minutes later, the second bird with check message to insure delivery. The weight to be carried is thus less than any electrical or radio apparatus. The birds fly directly to headquarters to which they have been trained, at about 50 miles per hour, whereas in impassable areas, a man runner might take two days for the same distance. The birds are well suited to the work and temperatures existing in large forest areas in winter as well as summer and are 98 per cent reliable. Suitable birds cost about $25 only in the United States and live for about $2 per year.

The Most Powerful Gun in Existence

IN the continual race between gun and armor, the gun easily maintains its lead. Even the 11-inch and 12-inch guns of the German fleet found no difficulty in penetrating the armor of the British ships; and it is only because the heavier British projectiles carried a defective delay-action fuse that they failed to get through the heavier German armor. In view of this superiority of the gun, it may seem surprising, at first thought, that the size and power of heavy artillery has been increasing during the war at such a surprising rate.

The following table showing the continual enlargement of calibers and corresponding increase in the weight of projectiles, shows the extent of this development at a glance. During the past decade we have seen the heavy guns of battleships and battle-cruisers grow from the 12-inch gun, throwing an 850-pound shell, to the British 18-inch gun throwing a veritable monster weighing 3,600 pounds—an increase of 50 per cent in caliber and about 450 per cent in the shell.



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The shells of the British 18-inch naval gun—the most powerful weapon in existence. Used against Zebrugge

TABLE SHOWING INCREASING SIZE OF GUNS

Caliber of Gun	*Weight of Shell*
12" naval	850 pounds
14" "	1400 "
15" "	1925 "
16" "	2100 "
18" "	3600 "

According to Sir Robert Hadfield, who specializes in the manufacture of armor-piercing shell, the 3,600-pound projectile of the two 18-inch guns which were first mounted on the battle-cruiser "Furious" and later on one of the British monitors, are by far the heaviest armor-piercing shells ever fired. The gun, according to *Engineering*, weighs about 150 tons, and at its maximum elevation of 45 degrees it can throw its projectile, which is 18 inches in diameter and 7 feet in length, to a distance of about 50,000 yards, or say 30 miles. In the trials of the gun, the shell, fired at a velocity equivalent to a range of about 14 miles, perforated a hard-faced plate 18 inches thick, which means that at that range, which exceeds, by many miles, the most extreme battle ranges of the late war, it would pass through the heaviest armor afloat.

The perforating power of the shell is shown graphically in the accompanying engraving, from which it will be seen that at point-blank range, the shell would pass through 41 inches of face-hardened armor, which is equivalent to a mass of steel 54 inches in thickness. At 10 and 20 miles respectively, it would perforate 22 inches and 12½ inches of face-hardened armor, and at the extreme range of 30 miles, it would get through nearly 12 inches of face-hardened armor.

Now, if, in this huge shell the proportion of weight of high-explosive filler to weight of shell is 15 per cent, it would mean that when the shell burst within a ship, over 3,000 pounds of steel would be hurled in every direction under the bursting energy of about 500 pounds of high explosive.

But how can a ship be hit at such distant ranges, where she would be hull down to the ship that was firing? The answer is to be found in the modern naval method of directing the gun-fire by airplanes launched from the ship itself. These, circling high above the enemy and spotting the fall of the shells, would send the results back to the firing ship. At these ranges shells would fall at a very steep angle, and the problem that is worrying the naval constructor today is how in the name of the impossible is he going to provide sufficient deck armor to keep the shells out. It begins to look as though the only defence of the future will be high speed and the steering of the attacked vessel on a continuously sinuous course.

Testing Automobile Tires on a Factory Roof

LOCATED on the roof of a large factory building in Denver, Colo., is a most novel track and mechanism for the testing of automobile tires, which has been made the subject of the cover illustration of this issue.

As will be noted in the accompanying illustrations, this track and mechanism is arranged to simulate the average conditions encountered by an automobile. The tire is attached to the free end of a pivoted arm, and is driven over the track by means of an electric motor. Switches and rheostats are provided for controlling the driving motor, while a standard speedometer gives the total mileage and speed. The track or "road" is quite a composite affair; part of it consists of loose rock, another of loose paving blocks, still another represents a railroad crossing, and so on to simulate every kind of road over which a pneumatic tire is expected to travel. In fact, part of the track is arranged as a double incline, so as to give the effect of grades. Whirling about this bizarre circular road the tire receives a thorough test, and at 1,000, 5,000, or any number of miles traveled, it is possible to determine the extent of wear and tear.

Shell Shock or Neurosis

THE Medical Department of the United States Army has found that the early conclusions regarding shell shock are not true. There is really no such thing as shell shock, although there are many cases of war neurosis. War neurosis is really not different from neurosis found beyond the war zone.

Neurosis whether found in the Army or among civilians, is a *sub-conscious* desire and the physical condition induced thereby to avoid a discomfort. In the Army, it is a *sub-conscious* desire to get to or to remain at the rear. However, it does not necessarily follow that the patient is lacking in courage, for there are many cases of war neurosis induced by the mental attitude of the patient concerning promotions, leave, alleged favoritism, etc. Among officers, neurosis is often induced by the responsibility occasioned by the demands at the front.

Investigation has shown that shell shock or neurosis is unheard of among prisoners, although they may be in fearful physical or mental condition, just as it is almost unheard of among wounded, excepting those who are about to be returned to their commands.

Emphasis should be laid on the fact that shell shock or neurosis is a *sub-conscious* attitude and a disease which must be cured. There are comparatively few cases of patients' faking.

Many soldiers having neurosis will remain uncured even after returning to civil life unless the disease is thoroughly understood so that proper treatment may be given.

From England to India by Airplane

WITH the arrival in Calcutta on December 18th last of a Handley-Page airplane, the first epoch-making aerial trip from England to India was completed. The landing of the huge biplane on the race course in Calcutta was witnessed by the Viceroy and Lady Chelmsford, the governor of Bengal, and an immense crowd of Europeans and natives, to whom the second appearance of an airplane in Calcutta was a great attraction. The trip was made without serious mishap via Egypt and Mesopotamia, a distance of about 6,700 miles by the route followed. An average speed of 85 miles an hour was maintained, and many stops were made. The original trip from London to Egypt was made for the purpose of military inspection, and it was then decided to continue to India, with stops in Mesopotamia, for further inspection duty. From Delhi to Calcutta the machine carried six persons.

There has been considerable discussion with reference to an aerial mail service between England and India, the British Aerial Transport Committee considering that the trip from London to Calcutta can probably be made in four days, as against the minimum of 18 days via Brindisi required by rail and ship. Investigations are now being made with a view to establishing an aerial mail service in India, and it seems reasonable to predict that within a few months one will be in operation. With the easily obtainable average speed of 70 miles an hour, the journey from Bombay to Calcutta could be made in 17 hours instead of 46 by rail, the Bombay-Simla trip could be cut from two days to 14 hours, and Karachi would be only 10 hours from Delhi instead of 48.

Timing the tire tester on the roof of a Denver factory

Taking the mileage reading of the tire tested over the roof course

THE S K F INDUSTRIES, INCORPORATED, announce the institution of a scientific organization for the study of anti-friction devices with the intention

—of setting on foot a thorough and scientific study of friction and the application of more improved anti-friction bearings;

—of offering to American manufacturers in every line, a bearing engineering service designed to investigate any manufacturer's bearing difficulties and offer advice as to bearings exactly adapted to his specific needs; and

—of endeavoring through the bearing knowledge developed in this manner and through its scientific investigations to be of assistance to the entire bearing industry in the improvement not only of design but also of methods of application.

* * *

With the conviction that American manufacturers will welcome assistance of a scientific nature in the solution of frictional difficulties, the S K F INDUSTRIES has established a service, entirely scientific in its intention, entirely divorced from the sale of any specific type, for the study of bearings in relation to manufacturing.

Heretofore, such assistance and advice have been rendered solely by bearing manufacturers as individuals. It is hoped, through concentration in one unified research, to organize the investigation of frictional problems and the giving of advice thereon in a more thorough manner, overcoming the past limitations.

The new bearing service will be both scientific and immediately practical. On the scientific side, centering in its engineering laboratories, which will be completely staffed and equipped for research of a difficult nature, it will undertake the investigation of the frictional difficulties and losses involved in the

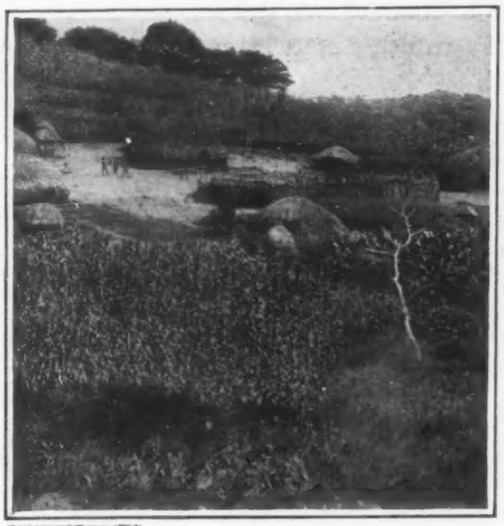
World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

Miles of Gold

"SIXTY cents for a lower berth in a sleeping car from New York to Chicago would be a bit more reasonable than the present rates, wouldn't it?" asked a merchant from South Africa during a recent visit to the United States. "That is the charge over a similar distance, from Cape Town to Johannesburg, in my country; it covers bedding, as we call it, for any continuous journey, regardless of length. Our dining cars, too, offer a greater variety of food at much lower prices than those in America. They are operated from one terminal to another and not attached to or uncoupled from trains en route. The government of the Union of South Africa controls 9,500 miles of railways and derives a profit from them.



Courtesy of George Birk

Our suburban customers in South Africa—a native village

"South African railway equipment is modern in every respect. So far, American manufacturers have made little effort to sell us materials and supplies, but not long ago an order was placed in the United States for 125 mountain locomotives for use on heavy grades. At the outbreak of the war the South African government cancelled a million-dollar contract with a German firm that had previously furnished motive power. There is a very good chance to sell American railway cars. Because of the steep climbs that our trains have to make through mountainous country I do not think all-steel cars can be used. South African sleeping cars are divided into compartments and have side corridors. The day coaches are generally similar to those in the United States. In normal years the total purchases of the South African Department of Railways and Harbors have amounted to more than $60,000,000. Under war conditions they have averaged $20,000,000, so that a shortage exists in many stores, and there is a good chance for American exporters to bid for this business. It has been exceedingly difficult to obtain rails.

Courtesy of George Birk

Our urban customers in South Africa—Rissik Street, Johannesburg

An Impressive Signboard

"Arriving at Johannesburg, the first object to meet the traveler's gaze is an advertising signboard 800 feet long. The posting of bills on this board is controlled by the railways, which also operate most of the other concessions. Johannesburg, with a population of 266,000 is the largest city in South Africa, although it was founded less than 30 years ago. The center of the greatest gold field in the world, it is surrounded by 47 miles of gold-mine shafts in a four-mile stretch. At present it requires 48 hours to make the journey from Cape Town to Johannesburg by rail. Airplanes have covered it in 11 hours, and attention is being given to the establishment of passenger and mail service by airplane in the comparatively near future.

"The telephone instruments used in South Africa are of European make. It is probable that with little effort the superiority of American instruments could be demonstrated, and that they would be bought in considerable quantities by the government, which operates the telephone and the telegraph systems. At present Norway and Sweden are sending telephone equipment to South Africa—out-of-date box telephones, which have proved extremely unsatisfactory for long-distance calls. The longest telephone line in the country extends from Johannesburg to Durban, about 450 miles. It is said to be difficult to conduct a conversation over this line, because of the indistinct receiving apparatus. The automatic telephone has not yet been introduced in South Africa.

"The market for farm equipment is attractive. Owing to the high price of gasoline—$1.08 per gallon at present—the sale of engines dependent upon this fuel is much restricted. On the other hand, kerosene may be bought for 36 cents per gallon, and apparatus adapted to it is in more demand. For machinery, cables, fittings and other material for electric light and power purposes, the South African market is worth more than $5,000,000 a year. When railway electrification is undertaken, and other new industrial projects are started, an urgent need will be created, representing very much more in annual value than the gross total of all electric imports into South Africa in the past."

Joiners' Planes in Demand

Before the war Germany conducted an extensive trade in South Africa in small tools of all descriptions, especially in joiners' planes. A careful study was made of the models chiefly in demand, and these were supplied at prices which made both England and American competition difficult. One of the best selling German jackplanes was made in red beech, without irons, and was stocked in four widths and one length (14 inches). A standard jackplane, modeled after the English pattern that was much used throughout South Africa, was 17 inches long and sold with or without irons in four widths. Trying planes were a very large export line introduced by German manufacturers, and other planes formerly imported by South African hardware merchants were those used for smoothing, roughing and molding.

Among the white population of South Africa, which is approximately 1,500,000, American wearing apparel in medium-priced grades is liked. As the additional millions of natives gradually acquire civilized customs, the sale of all sorts of clothing and articles of personal adornment will expand. There is not much chance of selling American leather goods in South Africa. A man from Johannesburg brought with him a large, well-made brief-case of South African manufacture for which he paid $50. The price quoted for the same kind of brief-case in the United States was $65, he said. A good quality of leather is produced in South Africa.

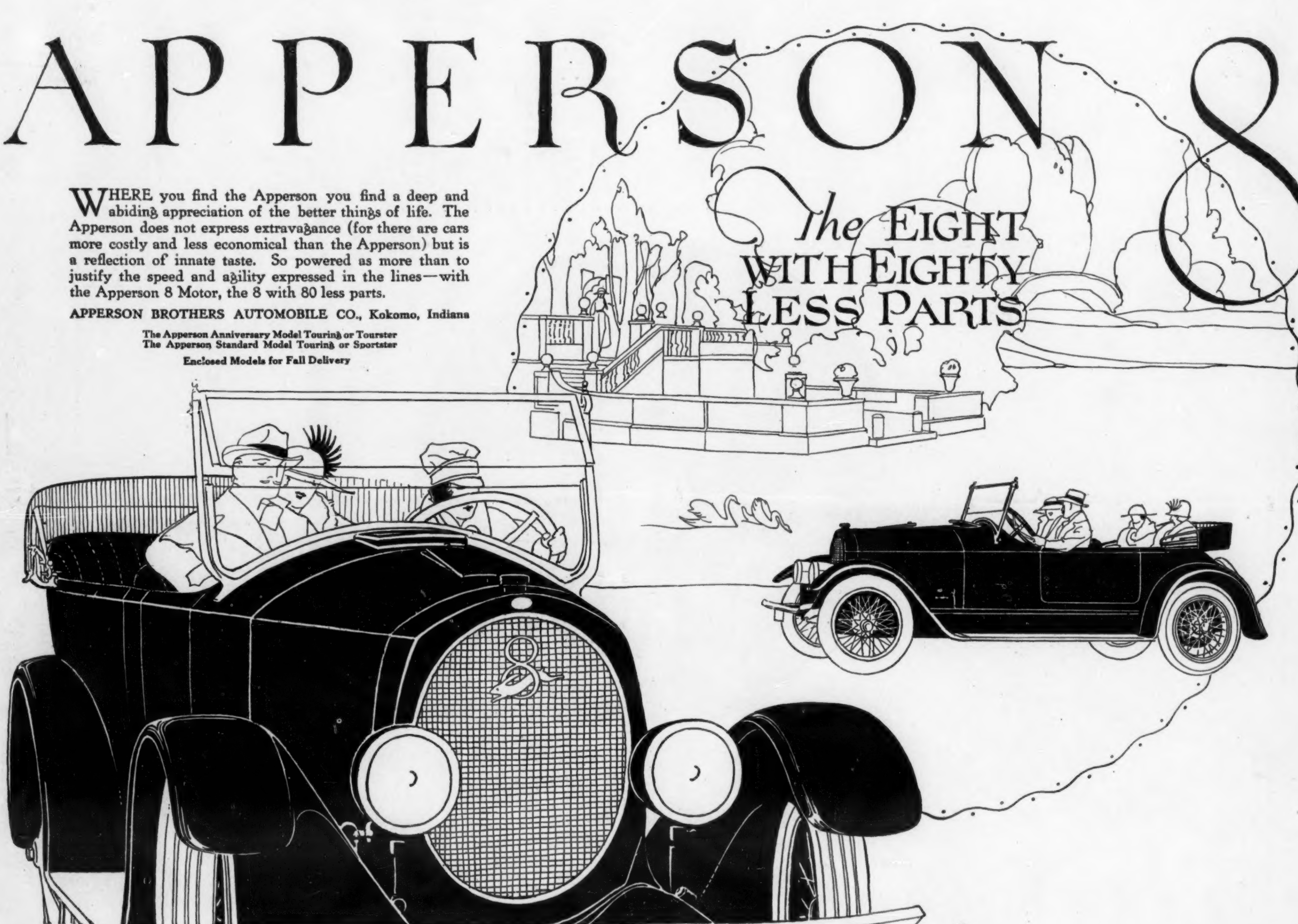
The American exporter has the choice of several South African ports to which to send his shipments. Cape Town is the principal import center, but goods consigned to the interior had best be routed via Algoa Bay (Port Elizabeth), where conditions for handling such freight are far better, railway facilities as compared with Cape Town being more adequate, and goods receiving more careful handling.

Naturally, Great Britain and its colonies have enjoyed the larger proportion of South African Trade. Among the merchants of the Union, however, America is one of the most favored nations, and all manufactured products from the United States are very well regarded. Practically every prominent importer handles American goods. So far as the tariff is concerned, importers from the United States and other countries pay three per cent higher duty than those from the British Empire. Most of South Africa's diamonds and tin reach the United States through London and Singapore. Direct steamship lines between American and South African ports would not only keep for us the larger share of business gained during the war, but would extend it materially.

Send Documents Promptly

Importers in South Africa have experienced much difficulty in clearing goods arriving at their ports on vessels sailing direct from New York, because the bills of lading are usually sent by way of England. This disadvantage may be understood when it is realized that cargo steamers, sailing direct, generally complete the voyage in about 30 days, while letters going by way of England take from 40 to 50 days. This means that the documents do not reach South Africa until 15 or 20 days after the goods have arrived by a direct route. The importer may obtain possession of his goods by executing a bond for the production of the bill of lading within a reasonable time, provided that duplicate invoices, properly itemized and containing the required customs declarations, are forwarded on the steamer taking the shipment. If this is not done, the South African authorities assess the goods according to their judgment.

All-American agents are needed for handling our trade in South Africa. One American manufacturer who introduced his products successfully through an experienced representative and conducted an extensive advertising campaign arranged an exclusive agency with a British firm handling one or two other American lines and ten or a dozen British articles. Sales were satisfactory for a few months, but after that they fell off steadily. Inquiry disclosed that a British manufacturer of the same line had appointed the South African firm his agent and sounded the death-knell of the American product.


APPERSON 8
The EIGHT WITH EIGHTY LESS PARTS
WHERE you find the Apperson you find a deep and abiding appreciation of the better things of life. The Apperson does not express extravagance (for there are cars more costly and less economical than the Apperson) but is a reflection of innate taste. So powered as more than to justify the speed and agility expressed in the lines—with the Apperson 8 Motor, the 8 with 80 less parts.
APPERSON BROTHERS AUTOMOBILE CO., Kokomo, Indiana
The Apperson Anniversary Model Touring or Tourster
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The Heavens in May, 1919

The Solar Eclipse of This Month, and What Astronomers Hope to Prove by It

By Professor Henry Norris Russell, Ph.D.

THE present month is notable for the occurrence of a great eclipse, which happens on the 29th, and affords the longest view of the surroundings of the sun, while its own disk is hidden, which has been possible for many years.

At the time of this eclipse the moon is within a day of perigee, and unusually near the earth—her distance being a little less than 221,000 miles. In consequence her tapering shadow is still nearly 150 miles in diameter where it reaches the earth's surface, and observers situated within the belt, about 8,000 miles in length, over which this shadow sweeps as it crosses the earth's disk, will see a total solar eclipse of unusual duration, which, at maximum, may amount to six minutes and fifty seconds.

The eclipse track is rather unfortunately situated. Beginning in the Pacific Ocean, just off the coast of Peru, it sweeps across South America, traversing the Bolivian mountains, the forests of Brazil, and the higher lands of the eastern coast. Then it crosses the Atlantic, almost along the equator, just grazes the southern coast of the great western projection of Africa, passes temporarily out to sea again, and crosses the main part of the dark continent by way of the Congo basin and Lake Tanganyika—finally leaving the earth's surface at a point in the Indian Ocean not far from the African coast.

The region within which a partial eclipse is visible extends far northward and southward, including practically all of South America except the extreme southern tip, and all of Africa except the Mediterranean coast. The region where totality is longest lies in the Atlantic, and the maximum duration of eclipse observable from land stations is about four minutes, which is reached on the east coast of South America and the west coast of Africa. There is, to be sure, one small island in the Atlantic, lying almost in the central line of totality, where the eclipse lasts fully six minutes; but as this spot, known as St. Paul's Rocks, consists of a few jagged rocks rising to a height of 60 feet from deep water, with no anchorage and no fresh water, it is hardly an inviting station for even the hardiest astronomer, in spite of the fact that certain optimistic souls have nominated it as a way station for transatlantic airplane flights.

The climatic conditions along most of the track are unfavorable—the best chances of fine weather being on the high lands back of the eastern coast of Brazil, and in central Africa above Tanganyika. On account of the remoteness of these stations, and of the disorganization resulting from the war, few expeditions appear to be projected to view the eclipse. One English and one or two American parties, however, are likely to make the journey.

It is to be regretted that the chances for observation are not more numerous, for this eclipse is of very considerable scientific importance. The usual observations of the "flash spectrum" at the moment when the sun's atmosphere is being hidden behind the advancing edge of the moon, or coming out again on the other side, can be made. The long totality affords an exceptionally good chance for observations of the corona and photographs of the spectrum. But the observations of greatest interest which are possible at this time deal with quite another matter, and one which is exciting a very lively interest among physicists as well as astronomers at the present time.

Motion—or Relative Motion?

For many years physicists have hoped and sought to devise some means of measuring directly the earth's motion through the ether which carries the vibrations and the energy of light. Successive experiments, of increasing ingenuity and delicacy, have all failed to detect any such effect—though in some cases it should have been very readily measurable. Finally their failure led to the birth of the now famous Theory of Relativity—a subject far too extensive and intricate to go into here, further than to say that its fundamental assumption is that Nature is of such a character that it is impossible to detect that any body or system of bodies is in uniform rectilinear motion by any physical experiment whatever, unless there is some other body outside the system—in which case the *relative* motion of the two, and that alone, is observable.

A remarkable extension of this theory has been made by the physicist Einstein—Swiss by birth, but long resident in Germany—who has attempted to include gravitational phenomena within the scope of his generalizations. His work is intensely mathematical, and extremely difficult; but certain consequences of his theory are easily comprehensible.

First: The elliptical orbit of any planet, if there were no other planets to perturb it, would not remain absolutely fixed in position, but its longer axis would slowly swing around the sun, at a rate which can be calculated from Einstein's theory. When applied to the actual planets, this theory gives results too small to measure, except in the case of Mercury; but here it accounts for a large discrepancy between observation and previous gravitational theory, which had been known, and had puzzeled astronomers for many years, even to the point of leading some of them to postulate an additional planet Vulcan, inside Mercury's orbit. Not merely this, but it accounts for these effects quantitatively, the calculated and observed effects agreeing almost absolutely.

At 12 o'clock: May 7.
At 11½ o'clock: May 15.
At 11 o'clock: May 22.

At 10 o'clock: June 7.
At 9½ o'clock: June 14.
At 9 o'clock: June 22.

At 10½ o'clock: May 30
Hours refer to summer clock time in effect March 31.

NIGHT SKY: MAY AND JUNE

This is a strong argument in favor of Einstein's theory.

But secondly, his theory also predicts that light originating in the sun, where the gravitational attraction is very strong, should have a slightly longer wave-length than light emitted by a similar atom on the earth—things happening as though the powerful solar gravitation slowed up the luminous vibration by a minute amount. Very careful measures by De St. John of the Mount Wilson Observatory show, apparently beyond question, that no such effect is present. So we are left again in uncertainty.

The Sun and the Light from a Star

This is where the eclipse observations come in; for thirdly: Einstein's theory predicts that a ray of light, passing close to a great gravitating mass like the sun, should be slightly bent inward, as though the sun attracted the light, and deviated it from its rectilinear course. This is in many ways the most remarkable of the consequences of the theory; but to determine by observation whether it actually happens is not easy.

The sun is the only attracting body within our range which is big enough to produce a perceptible effect. A ray of light which almost grazed its surface would be deflected by nearly two seconds of arc, while for rays passing at a greater distance, the deviation should be inversely proportional to their distance from the sun's center.

It is then easy to see that a star which we saw by light which had almost grazed the sun should appear to us to be shifted away from the sun's center, by the amount just stated. But we can only observe stars close to the sun at the time of a total eclipse; and one star alone will not do. We must have several, on different sides of the sun, and some nearer than others, so that they appear to be shifted in different directions and by different amounts. Then, by photographing them during totality and measuring the photographs, it should be possible to determine whether their apparent positions, relative to one another, have been altered as the theory demands.

The present eclipse is remarkably favorable for this investigation, not only because of its long duration, but still more because the eclipsed sun happens to be right among the star cluster of the Hyades, with numerous and excellent reference stars on all sides of it. An attempt will be made to get photographs suitable for exact measurement with instruments of long focus; and if only the weather is favorable, it ought to be possible to settle this important question once for all.

The Heavens

At our time for star-gazing, which is an hour later than through the winter, to allow for "Daylight Saving," we find Arcturus high in the south and almost on the meridian. Below him, and to the right, is Spica, while farther down and to the left is Antares, with the head of Scorpio above, and its tail dragging down to the horizon. Low on the southern horizon is a part of Centaurus. The two brightest stars of this constellation are invisible in our latitude, but at this time observers as far south as the Floridan peninsula may see them low in the south. Alpha Centauri, the easternmost of the two, is the brighter, and the line of the pair points toward the Southern Cross.

Returning to our own skies, we find Hydra stretched along the horizon from south to west, with Corvus above; then Leo, well up in the west, with Gemini setting in the northwest. The Great Bear is high above the pole, and so are the Little Bear and the Dragon, while Cassiopeia and Cepheus are low in the north. Cygnus and Aquila are low in the northeast and east. Lyra, Hercules and Corona are above them, and Ophiuchus and Serpens fill the southeastern sky.

The Planets

Mercury is a morning star this month, and is well visible at its beginning, as he reaches his greatest elongation from the sun on the 6th. Shortly after that date he rises at 4 A. M. (by the clock) and should be easily seen in the dawn. He is in Pisces, and much brighter than any fixed star in the vicinity.

Venus is an evening star, and exceedingly conspicuous, being very far north, and remaining in sight until well after 11 P. M. She is in conjunction with the moon on the 2d, being about three degrees north of her, and this will be a very favorable time to pick the planet up with the naked eye in broad daylight.

Mars is in conjunction with the Sun on the 9th, and is invisible.

Jupiter is an evening star, and is not far from Venus, higher in the sky before the 25th, and lower after.

Saturn is in quadrature east of the Sun on the 13th, and crosses the meridian at 7 P. M. by clock time.

Uranus is on the opposite side of the heavens and is in western quadrature on the 23d, so that he is observable before sunrise. Neptune is an evening star, observable only just before dark.

The moon is in her first quarter at 8 P. M. on the 6th, full at 10 P. M. on the 14th, in her last quarter at 6 P. M. on the 22d, and new at 9 A. M. on the 29th—the day of the great eclipse. She is nearest the earth on the 28th, and farthest away on the 13th. While she travels around the heavens, she comes into conjunction with Venus on the 2d, Jupiter on the 4th, Saturn on the 7th, Uranus on the 22d, Mercury on the 28th, and Mars on the 29th.

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The Current Supplement

PASTEUR originated an idea, about which furious controversy has ever since raged—the idea that there exist beneficent or physiologic micro-organisms, in addition to the pathogenic ones, and that the services of these little guests are vital to certain of the life processes of the host. Another controversy of recent years, seemingly with no bearing upon this one, has to do with the source of animal luminescence. Now comes Professor Pierantoni, of the University of Naples, with the claim that the two subjects coalesce—that in showing the light giving powers of certain animals to be due to micro-organisms harbored by them, he has at the same time proved Pasteur's case. His account of his investigations is translated for this week's SUPPLEMENT, No. 2261, dated May 3d, under the title *Animal Luminescence and Symbiotic Microbes*. Many other articles of interest will be found in this issue. Important for the exponent of industrial science is *Manganese Alloys in Open-Hearth Steel Practice*, which gives the results of a comprehensive investigation of this subject by the Bureau of Mines. Under the head of laboratory science may be mentioned *High Vacua and Their Measurement;* while the man who follows science for science's sole sake will be interested in *Fundamental Concepts of Physics*, which gives an account of an effort to effect for this subject the same precise formulation that Bertrand Russell and others have brought about in mathematics. A comprehensive account is given of an important agricultural industry of the Philippines in *The Coconut Palm*. The article on *Radio Telephony* is concluded, with a number of very attractive photographs of airplane and naval apparatus developed during the war. From a French contemporary is abstracted a discussion of *Animal and Vegetable Rennets*, a subject of more industrial consequence than the average citizen realizes. There are several good pictures, with accompanying text, upon *Our Liquid Fuel*. Among the shorter articles of interest. *The Homing Habit of the Pulmonate Mollusk Oncidium* deserves mention.

Our Largest Newspaper Presses

(*Continued from page 451*)

machine in each section consist of two parts of 16 pages each. If desired, however, the web after being slit in two can be carried over to a single folder so that a 32-page section will result. The method of folding the paper is clearly shown in the illustration. First the web is carried over a form that folds it lengthwise, then it is folded crosswise, cut, and dropped on a traveling conveyor. A special counting mechanism pushes every fiftieth paper a little further out, so that an accurate count of the number of papers may be had.

When it is desired to use more than one color the bottom web may be carried up through the cylinders above it, and they may be inked with color. In fact, a single web might be run through all of the cylinders of the section receiving eight different color impressions. When printing several colors, and when printing fine half-tone work, it is necessary to prevent offset of color on the impressions rolls and transfer of this color back upon the paper. This is prevented by the use of a roll of thin offset paper shown on the left-hand side of our illustration. It will be understood that the second web from the ground is not running and that the bottom web is running through the second row of cylinders to take on extra colors, then the offset paper runs around the second impression cylinder just beyond the first plate cylinder and is rolled up again on a take-up roll which may be seen behind the large roll in the illustration.

In a large machine of this character, the main problem is to supply the press with paper. The cylinders revolve at about 300 revolutions per minute, which means that the paper travels at the rate of nearly

(*Continued on page 469*)

Inventions New and Interesting

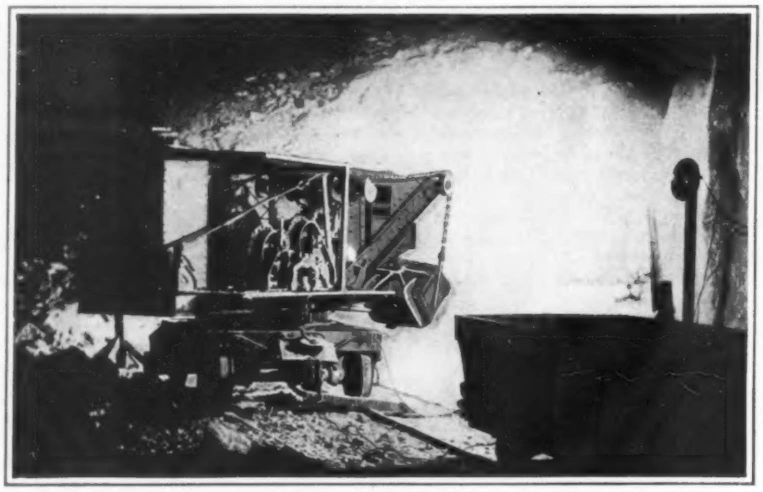
A Department Devoted to Pioneer Work in the Arts

Electric Shovel for Underground Mining

AN electric shovel designed for underground mining by an Ohio company, is a departure from the standard full-circle-swing type of steam shovel, its construction adapting it to the conditions peculiar to underground operations. Besides being designed for operation in restricted space, it is so built that it can be quickly dismantled for passing through narrow entries and passageways. The hoisting, crowding, swing and propelling movements operated by one man are all controlled direct from a single, constant-speed type of motor, equipped with friction control. The shovel, rotating through a complete circle, has the advantage of being able to work in any direction and to load cars quickly at the side of or behind the shovel.

Cost figures supplied by a northwestern iron company covering a period of four and a half years show a saving for the shovel over hand labor. The ore loaded was 25 per cent fine and 75 per cent lump, the largest pieces being 2 feet by 2 feet by 18 inches; the output, 150 to 220 tons daily.

Power curves for one of these shovels, equipped with a 20 horse-power motor, taken while loading five consecutive cars of iron ore, show an average of 16.86 horse-power. Operating in an iron mine in New York over a period of nine months, the shovel loaded 37,268 tons of ore into 13,022 cars; the cost figures announced comprise $4,824 for labor, $1,255 for supplies and $122.32 for power. This includes the expense of loading and tramming the ore about 300 feet and the expense of moving the shovel to different locations; and it brings the average gross cost per ton down to 16.6 cents, as against 30 cents under the same conditions by hand labor. The net saving for nine months was $5,000.



The electric shovel that reduces underground mining costs

A Housing Propeller for Small Boats

FROM Canada comes the ingenious housing propeller of which we show two illustrations. Everyone who has handled motor craft in shallow waters, particularly in waters infested with seaweed, grass and reeds, knows what trouble may be caused by these obstructions becoming entangled in the propeller. Also, where a landing has to be made in shoal water or over bottom that is covered with boulders, the possibility of the propeller striking bottom is the cause of much anxiety. The Toronto people who have brought out this device have made the propeller self-protecting. This has been done by inserting a universal joint in the propeller shaft and building within the boat a water-proof housing into which the shaft and propeller are automatically lifted on striking bottom, in passing over a sand-bar or rock, or in running the boat ashore on some sloping beach. The engine and the propeller housing are preferably installed so as to bring the entire weight amidships, and within this housing is placed a hinged protecting skeg, which pivots near the top of the housing and at its outer end is divided into two arms, one of which supports the outer bearing of the propeller shaft, while the other curves downwardly to a sufficient depth to act as a shield or guard to the propeller blades. The propeller can be raised or lowered by a hand lever which engages a ratchet; but in case of striking an obstruction, the ratchet is so adjusted that the propeller will be automatically lifted to a sufficient distance to clear the object. The housing is built water-proof and is provided with plates held in place by thumb-screws which can be removed for inspection when it is so desired.

Stopping the Engine Automatically When the Propeller Breaks

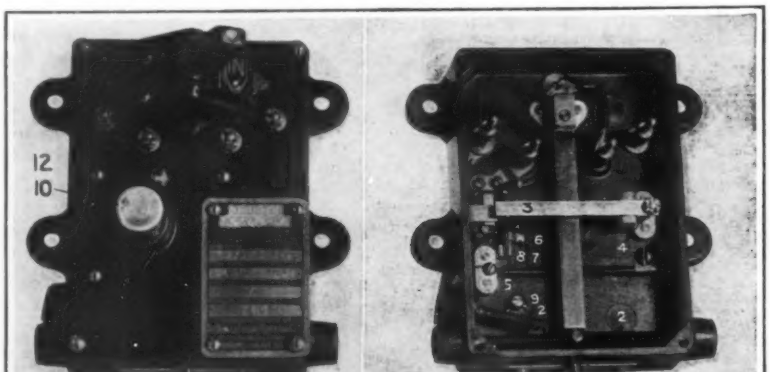
UNTIL recently the breaking of an airplane propeller while in full flight has always been accompanied by more or less danger to the passengers. In ordinary flying, as distinguished from military flying, the danger of such breakages is fortunately not so serious, though it is always present. With certain types of machines the danger is greater than with others. For instance, the tendency of a tractor plane, in the event of its propeller breaking, is to go into a dive, and of a pusher plane to go into a tail-stall. Under such conditions either type of machine is apt to pass into a spin as a result of the unbroken blade tending to swing the machine around a neutral, or pivot, point between the center of pressure of the unbroken blade and the center of torque. Other factors may increase or lessen this influence, and the engine may or may not go overboard as a result of the unbalanced torque reaction.

The resulting intense vibration is apt to break a gasoline line, and, consequent upon the continuance of the flame of combustion exhausting into the gasoline-charged atmosphere, be followed by fire. Sometimes the most perfect mental and physical coördination on the part of the pilot fail to prevent this, since the brain and hand can seldom act quick enough, as many thoroughly understood accidents of this nature attest. This manual limitation will be better realized when we consider that the time interval per revolution for airplane engines, assuming full throttle, varies from one twenty-third to one twenty-seventh of a second. Even under peace conditions some of our best pilots have been unable to prevent fatal crashes following such mishaps. This is particularly true at the present time with the high powered engines, high engine speeds, four-bladed propellers, and the general high stresses employed.

Under the auspices of the National Advisory Committee for Aeronautics, and with every facility offered by the Navy and Army air stations, Theodore Douglas of Brooklyn, N. Y., has developed an ingenious interrupter which automatically interrupts the engine ignition, thereby stopping the power development of the engine, in the event of the propeller breaking, or other similar breakage resulting in a seriously unbalanced condition of the power plant.

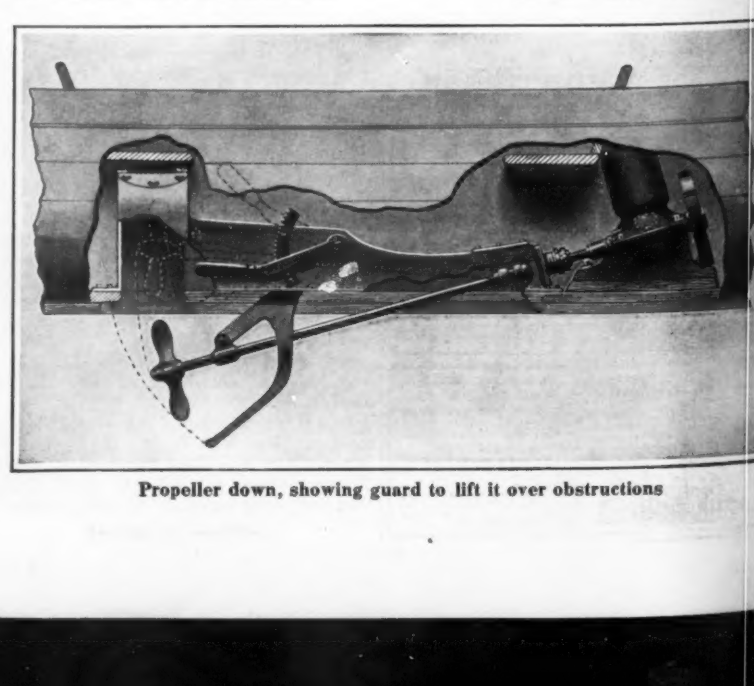
The interrupter, which is depicted in

(Continued on page 474)



Exterior and interior view of the interrupter for airplane engines

Housing propeller raised for inspection or repairs



Propeller down, showing guard to lift it over obstructions

Our Largest Newspaper Presses

(Continued from page 467)

14 miles per hour. In a quarter of an hour's time the big paper rolls are entirely consumed. Just before this happens the press must be stopped and paper from new rolls pasted to the ends of the webs and then the press is run slowly until the pasted joints have passed through. One hundred and eight miles of paper 6 feet wide are used each hour. This quantity of paper weighs about 18 tons.

The capacity of the press is 300,000 eight-page papers per hour or 75,000 32-page papers per hour. When running the machine as a color press, it will print 50,000 24-page papers per hour with the two outside pages printed in three colors and black. The machine is 48 feet long and 19½ feet high, weighing altogether 350,000 pounds. A better idea of its huge proportions, however, may be obtained by comparing the machine with the operators in the foreground.

America's Optical Emancipation

(Continued from page 455)

an appreciable amount of lead oxide is called a flint glass; without such amount of that oxide it is a crown glass. The different types and varieties of glass have different refractive indices and relative dispersions and are made to serve different optical requirements.

When the pot is filled with the ingredients, the mass speedily becomes liquid, in most cases assuming the consistency of thick syrup or glycerine. The temperature of the furnace is maintained until after the glass is ready to be stirred. This is determined by "proofs" taken at intervals by means of a long ladle, much as a houswife tests molasses candy in the making. The glass is stirred by a mechanical device, being accomplished by a clay rod on the end of a water-cooled tube. During the latter part of the stirring the temperature of the furnace is allowed to fall, and the stirring is continued steadily until the glass becomes quite stiff. This requires from 8 to 20 hours, again dependent upon the type of glass.

This stirring process is highly important. Upon it largely depends the elimination of those fatal defects of "strain" and "striae," or strings running through the glass, of a lower refractive index than the rest. The ingredients of the mixture are of different specific gravity; the more thoroughly all of the materials are mixed to render the whole mass homogeneous, the less the danger of striae.

The temperature of the pot of molten glass is accurately determined throughout by means of an optical pyrometer. This instrument contains a small, incandescent lamp, the color of which varies with the intensity of its heat, which temperature it registers on a dial. The furnace operator looks at the molten mass with the pyrometer, through a small aperture in the furnace door. When the color of the incandescent filament exactly matches the color of the glass, he reads the temperature.

When the melt is judged to be finished, the furnace door is lifted, and five or six workmen, trundling a long, portable crane into position, pick up the white-hot pot and transfer it to a cooling furnace, and another pot, previously heated, takes its place in the melting furnace. The entire process of melting and stirring has consumed from 24 to 48 hours, and the gradual cooling takes five or six days longer.

The pot is then taken from the cooling furnace and broken up. The resulting chunks of glass are examined, and those showing striae or other defects are thrown out. The apparently good pieces are sent into the pressing plant, where they are molded into blocks of regular shape in the small pressing furnaces. They are then ground and polished and inspected again for striae under parallel light, produced by specially designed optical instruments. The glass which passes this final inspection

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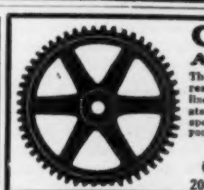
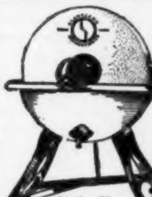
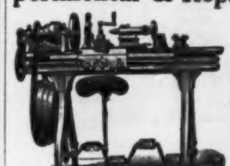






Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

MOLD FOR DUMMY AERIAL BOMBS.—E. V. Eskesen, Singer Building, New York, N. Y. The invention relates particularly to a mold for forming dummy aerial bombs of terra cotta, the clay for which may be dumped in measured or weighed quantity within the mold and by means of pressure forced readily and quickly to the desired shape without the difficulties and delay incident to known apparatus for this purpose.

Electrical Devices

DEFLECTOR FOR ELECTRIC FAN.—R. C. White, Jacksonville, Fla. The principal object of the invention is to provide a deflector which may be used in connection with electric fans of various types whereby the direct breezes created by the fan may be broken up and distributed, the result being that a greater area is cooled by broken or indirect air currents.

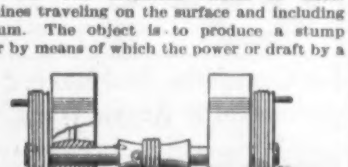
FLASHLIGHT.—H. M. Koretzky, care of Bright Star Battery Co., 310 Hudson St., New York, N. Y. The general object of the invention is to provide means for attaching the reflector to its holder, and means for providing contact between the central terminal of the battery and the central contact of the lamp, at the same time removing the thrust of the battery on such central terminal, and to provide a switch for closing the circuit continuously or intermittently.

SUPPORTER FOR ELECTRIC GLOBE SHADES.—C. L. Schafer and I. Arnow, 140 Claremont Ave., New York, N. Y. The object of the invention is to insure the service position of a defusing shade suspended below an electric globe, and to maintain the service relation of the shape of the globe. The invention comprises a plurality of bracing collars, reach bars vertically connecting the collars, a contractible hoop, and separated bracket arms connecting the hoop and the collars.

WELDING ELECTRODE.—B. W. Bowes, 2416 Ligamore St., Easton, Pa. The invention relates to carbon electrode holders for electric arc welding, the general object is to provide a construction of devices of this character, so designed that the operator can handle the holder with more comfort and safety, the shield and handle being so constructed as to reduce heating to a minimum.

Of Interest to Farmers

STUMP PULLER.—T. H. Monk, Thomasville, Ga. The invention relates to linear machines traveling on the surface and including a drum. The object is to produce a stump puller by means of which the power or draft by a



A FRONT ELEVATION OF THE MACHINE AT WORK

tractor or team is converted into upward pull so that the stump is lifted out of the ground and carried forward. A further object is to provide means whereby the machine can be drawn from place to place without necessarily turning its drum.

CORN HUSKING IMPLEMENT.—G. W. Ray, 465 2d St., Niagara Falls, N. Y. The invention relates generally to corn husking implements which are simple in construction and use, having a handle in the form of a wire loop, provided with a husking hook, a pad disposed against one side of the handle, a strap having one end associated with the pad, said pad having openings to receive portions of the wire loop, the strap having openings for the reception of the extension of the handle carrying the husking hook.

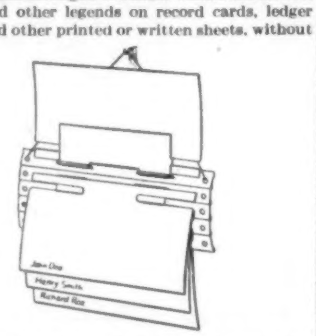
Of General Interest

FLY TRAPS.—J. M. Weir, 3614 11th St., Gulfport, Miss. The object of the invention is to provide a trap consisting of inner and outer panels, formed from a single sheet of perforate material, namely the common wire fly-screen cloth, bent upon itself. The trap body consists of two substantially conical members arranged in spaced relation one within the other. A suitable base is provided for supporting the trap and for supporting the bait container.

EGG PRESERVER.—R. G. Fleming, Sr., 5720 Elizabeth St., Chicago, Ill. This invention is a semi-solid composition for application to the shells of fresh eggs, for the purpose of preventing evaporation of the contents of the same, and also excluding oxygen from access to the interior through the pores of the shell and thereby causing early deterioration or decay of the contents. The compound is formed of ox fat, olive oil, beeswax, paraffin and boracic acid, to be applied to the eggs in a thin coat.

FILTER.—E. Northrop, Box 137, San Antonio, Texas. The object of the invention is to provide a filter especially adapted for removing impurities from gasoline and oil, to fit the gasoline or oil for reuse. The filter comprises a casing consisting of upper and lower sections, the upper having a series of threaded rings extending through its bottom, a filter unit connected with each ring, each unit comprising a screen section, a filter section detachably connected and a transverse screen, and filtering material held on the screen.

CARD INDEX.—J. R. Carroll, Norfolk, Conn. The object of the invention is to provide a card index arranged to render visible the names, titles, and other legends on record cards, ledger leaves and other printed or written sheets, without



A PERSPECTIVE VIEW OF THE INDEX AND CARD CARRIERS

requiring separating or fingering the cards. Another object is to provide a sectional support for the card carriers, the sections being detachably connected with each other.

LINE DOTTER.—V. Berkoff, care of Mrs. P. Horn, 149 S. Third Ave., Mount Vernon, N. Y. Among the objects of the invention are, to provide simple means for forming regular dotted or broken drawn lines, to provide an implement for assisting in the operation of drawing broken lines composed of marks of various lengths, to provide a device wherein provision is made for a variety of lines of standard characterization, and to provide an implement adapted to avoid blurring or blotting of the line executed.

ASH SIFTER.—J. Carroll, 65 Third Place, Brooklyn, N. Y. The invention has for its object the provision of a construction whereby ashes may be sifted properly and the usual dust or loose ashes separated by the sifting operation confined and caused to settle in a suitable receptacle without being deposited on surrounding articles. The device comprises a housing, and a wire cage movable at short back and forth movements for quickly sifting the ashes.

VISIBLE PAPER FEEDER AND CUTTER.—W. N. Ley, Box 1776, Spokane, Wash. The invention has for its object to provide a visible paper feeder and cutter which is adapted to feed paper for any desired purpose, the feeder having an opening through its top, which permits the user to examine the paper where held by the feeder, and which also affords access to the paper, tension members hold the paper at the feeder when the paper beyond the feeder is cut.

ANTISLIPPING DEVICE.—R. H. Cotter, 859 St. Johns Place, Brooklyn, N. Y. The invention relates to foot-wear. An object is to provide a simple and efficient contrivance which can be easily and quickly secured to a shoe and when so secured will prevent slipping, yet will not render walking uncomfortable. The device comprises an ankle strap, a pair of toe straps and chain sections associated with the toe and ankle straps.

COLLAPSIBLE PAPER HOLDER.—J. B. Faulkner, Official Stenographer's Office, Cincinnati, Ohio. The invention relates to collapsible paper holders for holding the paper used in the master model stenotype. The invention has for its object to provide a device of the character specified, that may be handled with one hand to turn and properly arrange the paper for transcription.

HAME.—J. B. Law, Darlington S. C. The invention relates particularly to hames of the nature shown in patents 241,676 and 249,641 granted to the same inventor. The object of the invention is to simplify certain of the hame connections so as to adapt the same to present day needs and promote the use of an article ordinarily used as a collar and made principally of wood whereby to conserve both metal and leather, of which ordinary collars are manufactured.

CUFF LINK.—G. P. Cragin, 201 W. Carlisle Ave., Spokane, Wash. The invention has for its object the provision of a device for attaching the well known stiff "four buttonhole" cuff, or the "eight buttonhole" folding soft cuff, to the wristband of the shirt in such manner that the cuff may be used as "link cuff" reversible after one portion thereof has been soiled.

COOLING OR COOKING BOX.—A. Boerner, Schweningen, Netherlands. The invention is based upon the fact that vacuum provides for the best insulation; it relates to a cooling and cooking-box wherein the insulation is obtained by a vacuum inclosing a chamber for receiving food or drink and wherein the vacuum is maintained by a water-driven suction pump, this pump being connected with the water supply pipe; the energy required for evacuating the air from the insulating space is practically obtained for nothing.

UMBRELLA LOOP.—H. C. Overin, 65-67 W. Broadway, New York, N. Y. The invention relates to an attachment for umbrellas, canes and the like, the object being to provide a construction which may be used as a loop for supporting an article to which it is secured on the wrist or by the hand in an easy manner. A further object is the provision of a band with a loop held adjustably against one side of an article for clamping the loop so as to straddle the article.

BIRD PERCH.—C. W. Mueller, 1099 Summit Ave., Jersey City, N. J. Among the principal objects which the invention has in view are, to provide a perch for birds which may be removed from service position during the absence of the bird, to provide perches which may be arranged one above the other, and in which shelves serve as protection for the birds on the lower perches. These perches may be used in fairly close relation, an advantage in transporting pigeons such as those used in military operations.

CARD-HOLDING ATTACHMENT FOR PENCILS.—A. B. Scott, Fairmont, W. Va. The invention relates more particularly to means for holding an identification card, such for example as a lodge card, or that of an officer or enlisted man in the Army or Navy, although the device may be employed for use in holding a calendar sheet or the like. The invention in its preferred form is especially designed for use in pencil cases of a known type in which the card may be held in rolled form and housed within the case.

INCUBATOR ATTACHMENT.—G. W. Doner, Osceola, S. Dak. The invention has reference to means which may be applied to existing incubators whereby access may be had to the interior of the incubator without affecting the atmospheric conditions within the incubator, for instance when removing hatched chicks, or when removing egg shells to prevent injury to chicks to be hatched.

MATCH BOX.—I. Blumenthal, 79 E. 121st St., New York, N. Y. An object of the invention is to provide an ornamental match box, in the form of an airplane. Another object is to provide support for the match box which is formed with compartments for various kinds of matches and to provide convenient striking members for the various matches.

POUCH.—J. Auer, 274 State St., Flushing, N. Y. The invention relates particularly to a tobacco pouch made of stiffened material. It is characterized by the provision of an auxiliary

VIEW OF THE POUCH, SHOWN WHEN CONTENTS ARE BEING DISCHARGED

opening through which the tobacco may be discharged, the device can be easily handled with one hand when discharging the contents which may be readily controlled. The pouch is particularly suitable for hand-made cigarette use.

ATTACHMENT FOR SHAVING BRUSH.—E. L. Hutchinson, Elks Club, No. 616, Honolulu, Territory of Hawaii. The invention has for its object to provide an attachment wherein means is provided for engaging the handle of a brush and to secure the said means in place, the means consisting of an arm extending transversely of the bristles at their free ends for rubbing in the lather as it is applied to the face to soften the beard.

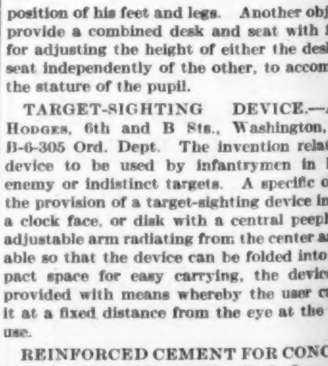
PROCESS AND APPARATUS FOR CRACKING AND DISTILLING HYDROCARBONS.—A. Cochran, 559 Madison St., Brooklyn, N. Y. The invention relates to the cracking and distilling of petroleum and other hydrocarbons for the production of gasoline, benzine, toluene and the like, its object is to provide a process and apparatus in a very simple manner with less production of carbon, a higher yield, increased production and uniform nature of the resultant gases and vapors.

MILK BOTTLE HOLDER.—P. D'Angelillo, 36 Forsyth St., New York, N. Y. The object of the invention is to provide a construction which may be slidingly fitted onto a door and after the door has been closed be automatically locked against removal until the door is opened. Another object is to provide a holder which automatically remains unlocked when an empty bottle is placed therein, and becomes locked when a full bottle is placed therein.

FOLDING AND GATHERING DEVICE.—A. Levett, 135 W. 79th St., New York, N. Y. The invention relates to a contrivance whereby suitable materials can be folded and gathered by a simple method which does not require a skillful operator and is therefore, economical. Another object is to provide a device which is particularly suitable for the manufacture of buffing wheels or circular brushes.

SHOE HEEL.—T. Hand, Orlando, Fla. The particular object of this invention is to provide a cushion heel which will be durable and lasting and which will wear evenly and uniformly during use both for the purpose of increasing its length of life and preserving generally the same appearance throughout such life. The invention is applicable to shoes for both men and women.

SCHOOL DESK.—J. J. McMillan, 31 Vestry St., New York, N. Y. The invention has particular reference to combined desks and seats. Among the objects is to provide a suitable support for a desk that will afford the maximum amount of comfort to the pupil with respect to the dis-



A VERTICAL SECTION, THE PARTS BEING IN NORMAL POSITION

position of his feet and legs. Another object is to provide a combined desk and seat with facilities for adjusting the height of either the desk or the seat independently of the other, to accommodate the stature of the pupil.

TARGET-SIGHTING DEVICE.—A. L. Hodges, 6th and B Sts., Washington, D. C., B-6-305 Ord. Dept. The invention relates to a device to be used by infantrymen in locating enemy or indistinct targets. A specific object is the provision of a target-sighting device including a clock face, or disk with a central peephole, an adjustable arm radiating from the center and foldable so that the device can be folded into a compact space for easy carrying, the device being provided with means whereby the user can hold it at a fixed distance from the eye at the time of use.

REINFORCED CEMENT FOR CONCRETE SHIPS CONSTRUCTION.—F. G. Jordan, 306 Indiana Ave., Washington, D. C. The main object of the invention is the provision of a fabricated form, which constitutes the main hull frame, in substantially a single piece. A further object is the provision of a main fabricated frame forming a part of the reinforcement for the cement or concrete, so arranged that the connected sections whose extremities are coupled to one another may be clamped, at all points of intersection so as to render the complete frame exceedingly strong although of a generally yielding nature.

(Continued on page 472)

America's Optical Emancipation

(Continued from page 469)

as usable is cut to the size and weight desired and repressed in the pressing furnaces into the approximate form in which it is to be used.

The culminating processes in the manufacture of glass for ophthalmic lenses are still more spectacular. The pot, after being taken from the melting furnace, is not allowed to cool but is suspended from an overhead track and hurriedly conveyed to a position above a large, iron casting table. On to this table the molten mass is poured in front of the huge iron roller, which is set in motion and the glass rolled into a perfectly even, flat sheet.

This glowing sheet is at once projected into the annealing oven, or "traveling lehr," as it is called, where it is slowly advanced into zones of constantly lowered temperature. The oven is approximately 100 feet long, and the sheet of glass requires about six hours to pass through it, the temperature ranging from approximately 1,200° F. to room temperature in the process. Annealing is the final process for all optical glass and is very important to its physical usefulness. In that process of gradual cooling under carefully regulated temperatures the molecular strain of the glass is relieved and the liability to breakage in future handling greatly lessened.

To quote Major Wright in conclusion: "The path leading to high precision is straight and narrow, and constant vigilance is required not to deviate from it. Optical glass is a thing of high precision."

This is another path which American industry has traveled, thanks to the ambitions of John J. Bausch and the unfaltering determination of his son to see them realized. And now as the father approaches his 90th birthday, he beholds—what he hardly dared dream of when he started his doubtful venture 66 years ago—America optically freed from the last trace of European dominance.

Increasing Visibility Through a Knowledge of Camouflage

(Continued from page 457)

which had for its purpose the deceiving of the submarine? The Jones visibility meter is now being utilized in a series of studies which have for their object the working out of schemes of painting which will insure the highest measure of visibility and emphasize the direction in which a vessel, for instance, may be heading. That is to say, the desire is to determine just what colors will make a ship conspicuous where now her somewhat indistinct appearance may confuse an observer regarding her actual course. The results already obtained show that red and black, for example, have marked visibility; and it is highly likely that these and other colors, when laid in a suitable manner upon the surfaces of a craft, will go a long way toward making clear a vessel's line of advance and, to just that extent, lessen the hazards of collision. The movement of shipping will be further aided by similar improvements in the coloring and marking of navigational guides, such as lighthouses, lightships, buoys and beacons. By parity of reasoning, aerial navigation and the finding of directional landmarks can likewise be facilitated. The semaphores and other signals employed by railroads may be made more positive by the adoption of new color coatings; and there are the best of reasons for believing that vehicular traffic in crowded thoroughfares and the ever widening tide of automobiles and motor trucks will find this outgrowth of camouflage of the utmost service.

The Invention That Won the War

(Continued from page 459)

in the center illustration on page 458. By means of rails in short sections and a system of steel cables, the wheels of the motor trucks could roll over the ordinary trenches and shell holes, because short rails were always directly in front when needed.

But to return to the work of M. Breton and Major Boissin, who during the earlier part of 1915 were urging the use of caterpillar tractors as tank mounts, because they appreciated the great tractive effort of such vehicles and their general maneuverability over all kinds of terrain. Casting about for tractor ideas, these inventors considered two American agricultural tractors, one of which had an excellent platform for the mounting of the tank body, while the other had a better means of propulsion. Taking the best of both designs, they set the Schneider works on the task of evolving caterpillar tractors suitable for tank construction. On December 12th, 1915, the French army Engineers placed an order for 10 caterpillar tractors with the Schneider organization, which were delivered some four months later. However, this number was considered much too small for any tank attack destined to overwhelm the enemy on a given length of front, and steps were taken by the inventors to interest the French high command, which up to that time had been most hostile to new ideas. Experiments were conducted during December, 1915, with caterpillar tractors, over the reconquered battlefield of Souain in Champagne, in order to convince the military men that these vehicles could operate over rough terrain. Still the military men were unconvinced! They admitted the ability of the tank to cross all obstacles, but pointed out its vulnerability to artillery fire.

It was then that Colonel Estienne, who has long since been made a general in direct charge of all French tank forces, became interested in the possibilities of the tank idea. He advocated the construction of a large number of tanks, and through his persistent efforts he finally obtained the necessary authorization from the French high command. From 10, the number of tanks on order at the Schneider-Creusot establishment, was increased to 400. In order to check up their plans, the French took two American Holt tractors and with their components constructed a single large tractor suitable for tank purposes, all in the short span of two weeks. During March, 1916, this improvised tank passed through the most rigid tests without difficulty, and was the cause of the French government placing another order with the Saint-Chamond organization for many more tanks. The details of both the Schneider and Saint-Chamond tanks are too well known from previous descriptions to require further comment here.

All the while the French kept the British authorities informed, the latter going ahead with their own tank experiments. While in external appearance the British tanks are different from the French, the propulsion and general details are quite similar. At any rate, because of their rapid manufacturing processes, the British were ready to employ their tanks in September, 1916, during the battle of the Somme, while the French Creusot tanks were just beginning to come out of the works. In fact, it has been pointed out that our British Allies were somewhat too hasty with the releasing of some 40 tanks which they then had ready; and if they had waited until the French also were ready, the combined attack might have had a more important effect on the surprised Germans. As it was, the Germans quickly recovered from their first scare and set to work organizing a tank defense which came to bear most heavily when the French opened up with their tank attacks during April, 1917.

Indeed, the first employment of the French tanks in the great battle of the Aisne during April, 1917, was more or less a failure, because tank tactics were little understood. M. Breton called the attention of the authorities to the misapplication of these weapons, and suggested their use as a means of surprising the enemy without the usual artillery preparation, just as Sir Julian Byng of the British forces had done in November, 1917, before

(Continued on page 474)

RECENTLY PATENTED INVENTIONS

(*Continued from page 470*)

Of General Interest

FISHING TACKLE DEVICE.—W. F. DARLING, P. O. Box 32, Derry, N. H. The invention has for its general object to provide a device which can be used as an automatic release for the sinker or weight when the fish makes a bite or strike, as a shock absorber so as to protect

VERTICAL SECTION WITH PARTS IN NORMAL POSITION AND SINKER ATTACHED

the hook, leader, line or rod from injuring or tearing the fish's mouth, and as a spinner when no weight or sinker is used, the spinner having a regular rotary motion and a zigzag movement.

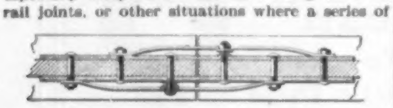
DRY DOCK.—W. F. HOHORST, 731 Bedford Ave., Brooklyn, N. Y. The invention relates more particularly to floating dry docks in which a float or caisson is formed with an open under side, whereby the water may be displaced therefrom by air under pressure to float the dock. The floatable sections of the dock may be completely submerged, and the dock then utilized for commercial docking purposes.

Hardware and Tools

LAMP BRACKET.—R. F. FERGUSON, Northville, Mich. The invention has for its object to provide a bracket capable of vertical, lateral, or radial adjustment. It comprises an L-shaped bar of circular cross section, an adjustable collar engaging each member of the bar, a sectional clamp connected with one of the collars for engaging a fixed support, and a plate for supporting the lamp.

EXPANSION SOCKET OR PLUG.—O. E. DROEGE and G. A. ROBINSON, 230 W. 123d St., New York, N. Y. Among the objects of the invention is to provide an expansion socket or plug which may be readily placed in position for securely anchoring screws or bolts in place in holes drilled in the wall of a building or other structure. Another object is to prevent the socket from shifting or passing too far into or entirely through the hole in the structure.

NUT LOCK.—E. M. ELTON, Atwater, Ohio. The object of the invention is to provide a device especially adapted for use in locking nuts on rail joints, or other situations where a series of



SECTION OF RAIL JOINT ON THE LINE OF THE BOLTS AND NUT LOCKS

nuts is desired to be locked. The lock comprises a plate of resilient metal, having at its centers laterally offset portion forming between each en of the strip and the laterally offset portion a transverse shoulder, to receive a nut and to lock it from turning.

JOINT FOR DRILL BITS AND OTHER PURPOSES.—H. HAUB, Pope Valley, Cal. This invention relates to joints particularly advantageous for embodiment in tools such as drill bits, chisels, and the like, although capable of a wide use in forming joints between the sections of a shaft or rod; with this construction the parts may be readily engaged, the head being given a tight fit when forced home.

PORTABLE HAND-PLANER.—J. H. BLOODGOOD, Jacksonville, Fla. The inventions relate to portable power driven hand planers, to be used in smoothing exposed surfaces of wooden or other structures and also adapted, dependent upon the cutter, to performing the operations on rough timbers, or to form a furrow or channel, or to prepare the seams in deck flooring or the sides of wooden ships preliminary to the operation of calking, the tools may be varied to vary the depth thereof, and provision is made for an adjustable face plate with means for simultaneously adjusting the opposite ends, the tools are both light and strong. Two patents have been granted to the same inventor.

Heating and Lighting

HYDROCARBON BURNER.—G. P. KITTEL, 535 Union Place, Union Hill, N. J. The invention relates to a kerosene or other hydrocarbon burner of such type that the liquid fuel supplied thereto is vaporized in transit to the jet orifice so that from the orifice a jet of high velocity vapor is discharged and entrains air that mixes therewith, whereby a large, hot blue flame is produced.

Machines and Mechanical Devices

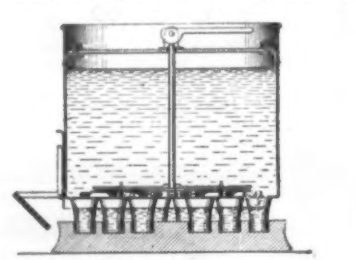
CYLINDER FLAT-FORM PRINTING MACHINE.—C. WINKLER, Berne, Switzerland. The invention relates to cylinder-flat-form printing machines, its object is to provide for a new arrangement of the parts of the driving mechanism, in the use of devices to obtain greater safety and more convenient manipulation, and further in effecting an economy of space, which is of great importance for printers.

COW MILKER PUMP.—M. E. JERNBERG, Erickdale, Manitoba, Can. This invention relates to a machine for milking cows, it has for its general object to simplify the construction and operation of apparatus of this character. A more specific object is to provide a multiple cylinder suction pump, the pistons of the pumps being operated by a single lever and the parts of the pump being readily taken apart for cleaning and repairing.

STEEL PULLER.—C. COVENEY, Tonopah, Nev. The object of the invention is to provide a device adapted for use in connection with drills of the jack hammer type, for preventing the drill bit from dropping out of the machine. The device comprises a frame having a pair of spaced plates, and a latch plate pivoted between the plates having a notch for receiving the drill stem and for preventing the passage of the collar.

BRICK OR TILE APPARATUS.—C. M. GROOVES, Hudson, Wyo. The invention relates more particularly to machines utilized in loading kilns, in connection with which bricks are formed and fed, the parts being adjustable for movement, so that kilns may be loaded from side to side, and the bricks fed at the required height for loading the kiln in tiers of bricks.

CUP FILLING DEVICE.—J. D. MCCABE, 1315 Union Bank Bldg., Pittsburgh, Pa. The invention relates to cup filling devices and has for its object the provision of a simplified struc-

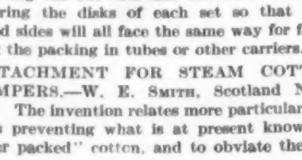


A LONGITUDINAL VERTICAL SECTION OF THE DEVICE

ture for filling groups of cups simultaneously, and with an equal amount in each cup. A further object is to provide a filling device for communion cups when arranged in their usual tray.

MILK BOTTLE CAP-MAKING MACHINE.—P. R. SIMMONS, care Caswell Runyon Co., Huntington, Ind. This invention relates to a machine for automatically printing and cutting out disks for milk bottle caps or other cut-outs from a continuous strip of stock and for automatically separating the cut-outs into sets and uniformly delivering the disks of each set so that their printed sides will all face the same way for facilitating the packing in tubes or other carriers.

ATTACHMENT FOR STEAM COTTON TRAMPERS.—W. E. SMITH, Scotland Neck, N. C. The invention relates more particularly to means preventing what is at present known as "water packed" cotton, and to obviate the dis-



A PARTIAL SIDE VIEW SHOWING THE APPLICATION OF INVENTION

advantage incident thereto, the prime object being the provision of means whereby to prevent leakage from the piston cylinder of a steam tramper from passing into the press box in which the cotton is compressed.

SHIFT MECHANISM FOR TYPEWRITERS.—M. N. TRONE, Hanover, Pa. An object of the invention is to provide a device for moving the platen of a typewriter into its upper position by temporary shift keys located at the left and right sides of the keyboard, and to provide a locking key which when depressed will shift the platen into its upper position and lock it in this position.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—G. J. COOPER, 1412 Bellville Ave., Seattle, Wash. Among the principal objects of the invention are, to maintain a relatively constant rotary pressure on a driving shaft and rotor, to secure free explosions in the explosion chamber, to admit to the explosion chamber and explosive fuel and an expansive medium successively and independently in timed relation to the operation of the rotor, and to utilize the heat incident to the full explosions for generating the expansive medium.

EMERGENCY VALVE.—C. WIDMANN, 26 18th St., West New York, N. J. This invention relates to safety appliances for factories, workshops, or the like where there is employed a prime mover for various machines, and has particular reference to means for instantly shutting off the steam to the engine whereby the engine will stop and the machinery quickly come to rest in the event of an accident requiring such control.

INTERNAL COMBUSTION TURBINE ENGINE.—F. LOBO, 265 20th St., Brooklyn, N. Y. Among the principal objects which the invention has in view are, to coordinate the functioning members of the engine to avoid vibration, to insure the timing of the engine, and particularly the fuel supply thereof, to simplify the construction and the action of the moving parts of the engine.

Railways and Their Accessories

CAR AXLE BOX.—J. R. FLEMING, 801 Monroe Ave., Scranton, Pa. This invention is especially designed for employment in mining car service. Among the principal objects which the invention has in view are, to provide means for lubricating the moving parts of a roller bearing, to provide a lubricating system for sealed bearings, and to strengthen the bearing construction and lighten the material forming the same.

PASSENGERS' SIDE PLATFORM FOR CARS.—H. J. PALMER, 243 Newkirk Ave., Brooklyn, N. Y. The invention relates to open cross-seat cars, and has for its general object to provide a combined protective cage and side platform whereby the passengers can travel longitudinally of the car without the use of a running board and be at all times protected from accident, the cage being adjustable into protecting relation at either side of the car, whereby the latter can travel on an up and down track with the platform at the outside.

REINFORCED RAILWAY TIE.—G. A. LE FEVRE care of Dr. Wm. C. Halleck, 122 W. 13th St., New York, N. Y. The invention relates to ties of reinforced concrete, the object being to produce a simple and strong tie which can be readily placed, which can be made at the point where it is to be used, and which is provided with reinforcement disposed in such a manner as to prevent the tie from crushing beneath the track rails, and also to prevent center bind.

Pertaining to Recreation

AMUSEMENT APPARATUS.—W. F. MANGELS, 2863 W. Eighth St., Coney Island, N. Y. The object of the invention is to provide an amusement apparatus designed for use in pleasure resorts, exhibition grounds and like places. In order to accomplish the result use is made of a track, a vehicle mounted to travel on the track, propelling means for propelling the vehicle, and rocking means for rocking the body of the vehicle in the direction in which it travels over the track.

GAME.—E. FLAGG, 109 Broad St., New York, N. Y. The invention relates to a war game in which the opponents are provided with identical sets of pieces representing an army, consisting of infantry, cavalry and artillery. The game is played on a checker-board, the object being to bring a cannon to the back row of the enemy's side and maintain it there during a single move.

TOY.—V. E. FERMIER, Forney, Texas. This invention relates to toys having movable figures, wherein a base is provided having thereon two figures, one of which is hinged to take an upright or reclining position and the other having a movable member spring operated to strike and knock down the first named figure and wherein releasable means is provided for restraining the operation of the striking member.

Pertaining to Vehicles

GEAR SHIFTING DEVICE.—G. Q. SEAMAN, 161 Monahan St., Brooklyn, N. Y. The object of the invention is to provide a gear shifting device arranged to shift the bears by power derived from the power shaft thus relieving the operator of undue physical exertion. In order to accomplish the result, use is made of a power driven mechanical means adapted to engage the shifting device of a change speed gearing to automatically shift from low to high speed.

SPEED CHANGING TRANSMISSION MECHANISM AND BRAKE.—S. V. DICKMAN, Shavertown, N. Y. This invention relates to a power transmission speed changing mechanism and brake device especially adapted for use in automobiles, airplanes, and other power driven vehicles, it has for its general objects to transmit power from a motor or driving shaft to a driven shaft without appreciable loss, and to permit the operator to readily vary the speed of the driven shaft to any desired degree without changing that of the motor.

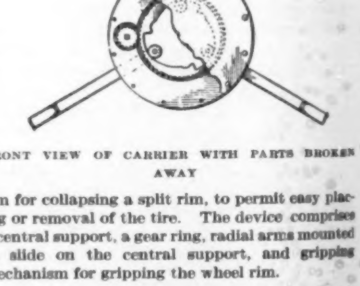
TRUCK.—J. C. HICKEY and O. J. CANTRELLE, 4314 Lawrel St., New Orleans, La. This invention has for its object to provide mechanism for use in connection with the usual freight truck, either hand or motor operated, for depositing and stacking the load automatically. With the invention the necessity for handling grain in bags, or packaged stuff, separately in unloading, is eliminated.

RECTIFIER FOR AUTOMOBILE GENERATORS.—L. R. TITCOMB, Danville, Ill. The invention relates more particularly to rectifiers for the current generated by the Ford magneto. An object is to provide a simple device which may be secured to the crank case of the engine and which will rectify the alternating current or a portion thereof so that a storage battery may be charged when the engine is running.

RADIATOR.—F. W. KEEGAN, 159 E. 36th St., New York, N. Y. The invention relates to a radiator for use on automobiles, and more particularly to a radiator in which corrugated water tubes and intervening corrugated radiating elements jointly form a series of air cells transverse to the general direction of the water tubes.

CHAIN AND OTHER ANTISKIDDING APPLYING DEVICES.—E. H. WHITE, 19 Baltimore St. Cumberland Md. The object of this invention is to provide mechanism for use in connection with motor vehicles for permitting tire chains and other antiskidding devices to be automatically applied to the wheels or removed therefrom while the car is in motion and without the necessity of handling the chain or the wheel.

TIRE CARRIER.—T. J. COLLINS and R. B. JORDAN, 1407 Ave. D., Brownwood, Texas. The object of the invention is to provide a device which may be attached to an automobile to carry an extra tire and which is also provided with mechan-



FRONT VIEW OF CARRIER WITH PARTS BROKEN AWAY

ism for collapsing a split rim, to permit easy placing or removal of the tire. The device comprises a central support, a gear ring, radial arms mounted to slide on the central support, and gripping mechanism for gripping the wheel rim.

Designs

DESIGN FOR A WRAPPER.—M. S. TROY, 14 and 16 Hopkins St., Brooklyn, N. Y.

DESIGN FOR A SNOW SKATE.—W. A. ERICKSEN, 235 61st St., Brooklyn, N. Y.

DESIGN FOR A SHOPPING BAG.—E. A. FINN, 129 Franklin St., Springfield, Mass. This ornamental design relates to a lady's shopping bag.

In getting back to a peace-time basis every industry, large or small, can obtain valuable engineering assistance from the General Electric Company

Back to "Cits" Again!

how electric power helped an industry "about face" twice in the same year

TO equip and keep an army of four million in clothes was the task set for the textile industry. No notice to get ready was given; no time to prepare—just orders to do it, and do it quickly.

Then, the armistice—from a clear sky the signal to get ready for demobilization—to get back to making "cits."

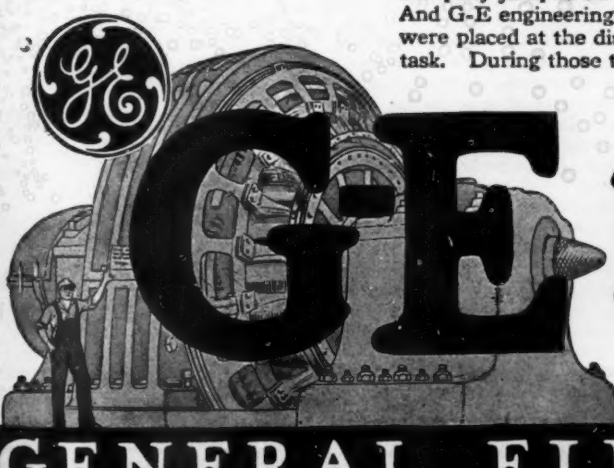
Only those close to the men responsible for production know how the textile mills passed through these two crises. Wires hummed with "help us all you can" and the quick answer came, "count on us to the limit."

Mill power specialists of the General Electric Company jumped off trains in town after town. And G-E engineering and manufacturing facilities were placed at the disposal of the mills facing the task. During those trying days a G-E Specialist was "the man of the hour," and it is a matter of record that electric power solved many a knotty production problem.

In the cotton, woolen, and worsted mills throughout the country, 75% of the electric power used passes through G-E Motors. The largest mill building in the world (The Wood Worsted Mill of the American Woolen Company, at Lawrence, Mass.) is equipped with General Electric Motors supplying 16,000 horsepower. G-E Motors also predominate in the great workshops of America's clothing manufacturers.

These accomplishments in the textile field are an example of how the General Electric Company serves American industry. Its great manufacturing plants, its corps of engineers, its power specialists—never further away than a few hours' ride—are at the service of every manufacturer.

Look for this—
the mark of leadership in electrical development and manufacture



G-E motors

—from the Mightiest to the Tiniest

GENERAL ELECTRIC COMPANY

The Invention That Won the War

(Continued from page 471)

Cambrai—which was, after all, the original purpose of the tank idea.

During the earlier part of 1918 M. Renault, a French automobile engineer, began turning out small two-men tanks in large numbers. These tanks were considered more suited to tank tactics than the larger tanks, for after all it is large numbers and small size which counts most with tanks. The British followed suit with their "Whippets."

And then, during the Allied offensives starting with the great counter attack of July 18th, after the German drives had expended themselves, the huge tank fleets of the British and French armies came into play. With little or no artillery preparation, the enemy was caught here and there along the long line without warning. His reinforcements were never where he required them, for that was one of the great advantages of the tanks. His barbed wire and deep trenches counted for little, for the little tanks got over them and set to work with their cannon and machine guns.

The German anti-tank defenses failed to stop the Allied tank fleets; there were too many of them even after the enemy had inflicted heavy casualties. Up and down the line, where the Germans had long held superior numbers at bay because of their barbed wire and numerous machine guns, Allied troops came through in overwhelming numbers behind the moving walls of tanks. Collapsed German defenses, retreating armies, disorganized supply lines, and finally a more or less complete rout brought the supposedly invincible German army to its knees. And from that point on, the story is well known.

After all, the tank and its proper employment proved the one tactic which conquered a powerful and well intrenched foe. Before the tank was introduced, large numbers of attackers fell before the barbed wire and intense fire of the defenders. Artillery preparation made the attack all the more difficult, by giving warning and by making the terrain impassable for supplies and the supporting artillery. With the coming of the tank, however, the barbed wire belt lost its defensive value; and today the advantage again rests with the attacker.

Stopping the Engine Automatically When the Propeller Breaks

(Continued from page 468)

the accompanying illustration, supplements the action of the pilot in such instances, and through practically instantaneous action interrupts the power development, thereby confining the danger to the initial breakage. Such a breakage is seldom serious in itself. The interrupter is particularly desirable on twin-engine machines, as such an accident happening to one engine would cause the good engine to tend suddenly to swing the machine around and probably into a spin. On such machines the interrupter may be so installed as instantly to cut out both engines, thus maintaining an approximately normal flying position. The pilot then has the alternative of making a landing with dead engines, or of switching off his damaged engine and continuing his flying with his good engine and reduced speed. In the equipment of "blimps" and other dirigibles the instrument would find another important application as it would tend to reduce the fire risk following propeller breakages, as the propeller fragments are apt to puncture the gas bag.

As to the elements of the design of the interrupter, these are extremely simple and may be described as consisting of a suitably pivoted metal bar, so mounted as to swing in a plane transverse to the axis of rotation of the propeller. By means of tension springs 2-2, the free movement of this bar is confined, under normal airplane operating conditions, to a very limited arc in its plane of movement. The amplitude of this movement is determined by the weight of the bar, the intensity and frequency of the transverse vibrations of the engine, and the opposing strength of the springs confining it. The extended end of the trigger 3 is constantly pressed toward the floor of the instrument by the compression spring 4, and is designed to engage the latch 5. On the under side of the trigger 3 there is an inclined surface 6, by which the trigger is raised. A ball-pointed hardened steel screw is fitted into the bar directly beneath the trigger, and designed to engage an inclined surface and thus to lift the trigger when the swing of the bar is sufficient. When the trigger is lifted the latch 5, held under tension by the spring 7, is released and moves out of engagement with the trigger. The cam 8 is for the resetting of the latch through rotating it back into position by means of the push button 10 from the outside of the instrument.

Now the compression spring, presenting an unbalanced force, is designed to prevent the bar from disengaging the latch 5 as a result of cylinder misses coinciding with bad vibration periods of the engine, etc., thus increasing the amplitude of the swing of the bar through synchronism, or from lateral shocks to which the plane may be subjected in landing. An intense oscillating shock transverse to the axis of the engine, such as an unbalanced engine-propeller torque reaction resulting from the breaking of a propeller at speed, are the types of shock from which the instrument is designed to operate, and to which it will immediately respond. Under such conditions the bar will swing through its full amplitude, raise the trigger, which releases the latch, and thus interrupt the ignition through grounding the magnetos. From the interrupter terminals 11 and 12 wires are connected to the grounding terminals of the magnetos, and from top terminal of the interrupter a wire is connected to the engine ground. On the disengagement of the latch 5 triple contact is made between the interrupter terminals.

The interrupter can be made in two general types—maker and breaker instruments—and in various models for adapting it to various systems of ignition.

How Long the Oil Will Last

(Continued from page 459)

to year and from decade to decade, it might not be so difficult to see where the oil for the next few generations is to come from; but when each generation demands from four to eight times as much as its fathers used—well, there comes a time when it can't be done any more. And if anyone desn't believe that we are now face to face with the time when the normal expansion of petroleum consumption must be curtailed, he is respectfully invited to contemplate one fact; all the oil that has been extracted from the earth since the beginning of the industry, as indicated in the last section of the diagram, would last, at the 1917 rate of consumption, less than 15 years. It would last, at the 1917 rate plus the ordinary increment shown for each year since 1880, a period of less than 10 years.

So it is not in the least reasonable to suppose that we can find, indefinitely, oil to use on any such expanding scale, or, if the oil were to be by some miracle found, that we could produce at a sufficiently accelerated pace to meet the demands of such consumption as outlined. On the whole, then, it would be difficult to imagine a more thorough graphic demonstration than the one our London contemporary has given of the fact, recently brought out in our editorial columns, that the future of industry is largely in the hands of the internal combustion engineers, through their efforts to develop satisfactory engines to be used for burning other fuels than gasoline.

Giant Monoplane Flying Boat—Count Zeppelin's Last Production

A MEMBER of the Allied Naval Commission in German waters, writing in the London *Times*, gives an interesting description of a giant monoplane flying boat, which he saw at Nordeny, one of the largest and best-equipped of the German seaplane stations, and which represents Count Zeppelin's last efforts in aircraft design.

This flying boat has a wing spread of about 130 feet, which is exceeded by that of a number of Allied and German machines, but an unusual breadth of wing of between 15 and 20 feet. In surveying the great expanse and solidity of these wings an American officer remarked, "If a Sopwith 'Camel' couldn't fly off it while that monoplane is in full flight, I'll eat it." It is quite probable that this remarkable machine would provide a "platform" from which the fantastic conception could be realized. There would be less room than on the turret of a battle-cruiser, but the greater speed of the monoplane as compared to a warship would unquestionably cause a small machine to rise without a foot of run. One could all but stand upright in the roomy "boat," and there are a number of places in some of the earlier types of submarines where one would be more cramped for space. The hull of the boat was largely of steel and duralumin, and looked to be from three to four times the displacement of that of the earlier types of Curtiss flying boats, and incomparably more comfortable. Nor was the boat the only enclosed space. Between the wings was a stoutly built house for a pilot, and containing, among other things, a soundproof room for the wireless operator.

One of the German flying officers of the station gave a brief history of this remarkable machine. "The giant monoplane flying boat," he said, "was the last gift of the great Count Zeppelin to the German people. He completed the design of it before he died, but most of the construction and all of the experimental development of it have been carried out since. Count Zeppelin was terribly disappointed over the failure of his airship as a bomber, on account of the way it could be destroyed both by gunfire from the ground and by airplanes. Before the war he had hopes that the Zeppelin might be used for bombing enemy lines, but it did not take long to prove that the risk of losing it was too great. He realized that it was no good for this kind of work even before the Zeppelins began to be destroyed over England. So he set himself to devise a heavier-than-air machine powerful enough to carry a great weight of bombs, for use at the front, and this monoplane flying boat is the result. Because Count Zeppelin, at the time he designed this machine, did not believe it possible, on account of its great size and weight, to land it safely on the earth, he decided to make it of the flying boat type. It was to be kept at one of the seaplane stations on the coast of Belgium, to rise from the sea, to fly over the front on bombing raids, and to land again in the sea. He chose the monoplane type on account of the trouble we have always had from the lower plane of a biplane being knocked about by the waves in a rough sea. This one great plane, over four meters above the water, is never touched by a wave unless the boat heels over very much when caught with a beam wind and sea. As it is built to turn up into the wind of itself, even with its engines disabled, that contingency almost never arises. Before the Giant was ever used for bombing as Count Zeppelin had planned, experiments had proved it possible to land large airplanes safely on the earth. As that made it possible for bombing raids to start nearer most of their objectives than if they had been pinned down to coastal stations, the Zeppelin flying boat had to be turned to another use, and in this way it came to be turned over to the Naval Air Service for long-distance reconnaissance. For this work it was proving highly satisfactory, although it had to be flown—and especially to be landed—very carefully. We were using this one principally to train pilots, so as to have plenty of skilled men ready to fly a large number of similar machines we had under construction. Whether these will be completed now, I cannot say. At any rate, we are convinced here that it is the best and safest machine for long-distance flights over the sea that has yet been designed."

Gluing Veneer at Higher Moisture

IN ordinary commercial work it has been common practice among plywood manufacturers to dry their veneer down to very low moisture contents before gluing. This is accomplished either in plate redriers, textile driers, or similar apparatus. The object apparently has been to prevent shrinking of the veneer in the finished panel and the consequent marring of its appearance. In the manufacture of waterproof plywood for aircraft use it was required that the veneer contain between four per cent and seven per cent moisture at the time of gluing. This is higher than was customary in many plants, but was still below ordinary air-dry moisture conditions.

In a recent investigation by the Forest Products Laboratory of the U. S. Forest Service at Madison, Wis., veneer was glued with casein glues at various moisture contents up to over 50 per cent. It was found that when very dry veneer was glued the tendency to failure in the moisture resistance tests was greatest. Veneer glued at 15 or 20 per cent moisture or above gave practically perfect results in the water tests.

The panels made at the higher moisture contents were apparently as strong and as desirable as those glued under ordinary conditions, but showed a tendency to check if dried too rapidly. It should be possible, however, by proper regulation of the dry kilns to dry the wettest panels satisfactorily.

These results indicate that it may be possible to reduce very materially the cost of producing panels of certain kinds where finish is not important, by using water resistant glue and greatly reducing or even eliminating the preliminary drying of the veneer. Veneer when very dry is more liable to break or split than it is at higher moisture contents. An additional saving is, therefore, possible by reducing waste.

It is realized that the use of moist veneer is not practicable for many purposes, but it is quite certain that veneer is now being very carefully dried to low moisture contents for many kinds of panels which might be glued to good advantage at higher moisture.

The above results were obtained with casein glues. It is known that damp veneer can also be glued with blood glues. It is unlikely, however, that moist or wet veneer would be suitable for glues which are not water resistant.

Recovery of Waste Paraffined Paper

IN the process of manufacturing paraffined paper and various products such as cartons, cups, and wrappers, large quantities of impregnated paper stock are now wasted. In the making of paraffined paper alone, it is estimated, the daily waste amounts to 8 or 10 tons.

An opportunity for the recovery of a large part of such waste paper and impregnating material is offered in the application of a method recently developed at the Forest Products Laboratory, providing mill trials are as successful as the semi-commercial laboratory work indicates.

The recovery method consists in treating the finely shredded waste with petroleum oil solvent in a series of extractions, which removes practically all the paraffin. The paraffin is afterward separated from the solvent, which is used again. The solvent left clinging to the extracted paper is also recovered by a steaming process. A paper fully as strong as the original can be made from the remaining pulp.

NEW BOOKS, ETC.

Home Made Beverages—The Manufacture of Non-Alcohol and Alcoholic Drinks in the Household. By Albert A. Hopkins, New York, 1919. The Scientific American Publishing Company. 16 mo. 233 pages. Price in New York $1.25. East of Chicago $1.30. West of Chicago $1.35.

Without holding a brief for either the prohibitionist or those who wish to manufacture innocuous beverages at home, this little book is offered in the hope that its catholicity will appeal at once to the "pros" and the "antis," for herein will be found everything from strong wine to lemonade. In any event, the information contained will be of interest even in this seemingly dry northern half of our hemisphere of the world. We do not wish to praise this book unduly so we will let the press notices extol it. The Chicago *Tribune* says: "Most timely book of the month." The Grand Rapids *Press* says: "Well, here it is at last." The Harrisburg, Pa., *Evening News* says: "The book is valuable in any household whether the cellar is 'wet' or 'dry,' for by far the majority of recipes are for drinks without a 'kick' in them." The *Patriot*, also Harrisburg, Pa., says: "Here is hope for the man whose eyes droop as they rest on July 1st in the American calendar. Apparently all is not lost for him if Mr. Hopkins' formulas are followed." Hudson Observer says: "The formulas will be helpful, for one of the dangers feared when prohibition becomes effective is that persons who desire alcoholic beverages will do as they are doing in Norway, making strong, poisonous concoctions that are wrecking the unfortunates who drink them." The Duluth *Herald*, Duluth, Minn., says: "This book offers a refuge from the excesses of the dry period. There ought to be a large field for this book which comes just in time." The Hartford *Daily Courant* says: "The author has just published this collection of recipes at this particular time believing that 'people, that is, most people, will want to be informed before the day of wrath, July 1st.'" The Trenton *Sunday Times*, Trenton, N. J., says: "With the rapid approach of prohibition days, one is apt to take more interest than formerly in a work like 'Home Made Beverages' In order to set at rest any uncertainly as to the character of these beverages, a sub-caption describes them as 'non-alcoholic and alcoholic drinks.' There is nothing puzzling about the recipes, Mr. Hopkins having made special efforts at clarity." The Boston Evening *Record* says: "A book for study and for daily use." The Milwaukee *Journal* says: "The wise chaps who are able to put their fingers on the public pulse, or think they can, tell us that with the abolition of liquor traffic, scheduled for July morn, there will be a great increase in what has been regarded as a prosaic industry, the making of beverages in the home. Seriously, Mr. Hopkins has done an exceedingly creditable piece of work. The volume will be found very useful by every one interested in preparing his own beverages." The Pittsburgh *Gazete Times* says: "Not because of threatened bone-dry conditions, but because a standard work on 'Home Made Beverages' is much in demand, this book has been brought out. If you make things of this kind you had better makethemright so that you will run no risk of being injured by them." St. Louis *Dispatch* says: "Many will go into the dry era with a sufficient stock of alcoholic beverages on hand to keep them going for a long time, but the vast majority will be put to the necessity of finding substitutes for alcoholics in the way of social drinking. These will find this book of great value in helping them to solve their problem." The Philadelphia *Inquirer* says: "The information is concise and precise. It tells just what is necessary and any housewife can do all of the work with satisfactory results."

The British Journal Photographic Almanac, London: Henry Greenwood and Co., Ltd., 1919. 8vo.; 642 pp.; illustrated. Price, paper, 1s. 6d. net; cloth, 2s, 6d. net.

Among the many acceptable offerings of this long-established annual are the sections summarizing the progress of the year 1918 and including apparatus and equipment, negative and printing processes, and color photography, numerous formulas, a generous selection of tables, and a great deal of miscellaneous information. There are also directories and descriptions of the British societies and bodies, and a fine frontispiece illustrative of the high excellence attainable by the machine-printed photogravure.

Farm Science. A Foundation Textbook on Agriculture. By W. J. Spillman, D.Sc., Chief of the Office of Farm Management, U. S. Department of Agriculture. Yonkers-on-Hudson, N. Y.: World Book Company, 1918. 8vo.; 344 pp.; illustrated. Price, $1.28.

The farm boy is surrounded by phenomena that call up questions in his mind; this book sets itself to answer them. It disregards abstruse and merely local problems and deals only with fundamentals. The soil, the plant, the animal, the farm, all present to the active mind questions that are here scientifically but simply answered. The experiments given call for no apparatus that cannot be found among, or improvised from, the farm's resources, and the arrangement of material adapts the book for classroom use without demanding a teacher who is himself an agricultural expert.

Chimica Inorganica. Vol. I. Part 2. By Ettore Molinari. Milan: Ulrico Hoepli, 1919. 8vo.; 630 pp.; illustrated. Price, L. 26.

The author of this substantial work is a well-known professor of chemical technology at Milan. This is a fourth edition, revised and amplified, of his "Inorganic Chemistry": it reveals a thorough treatment of the subject, with particular reference to industrial applications, and will commend itself to those who can read Italian with facility.

The Elementary Nervous System. By G. H. Parker, Sc.D. Philadelphia and London: J. B. Lippincott Company, 1919. 8vo.; 229 pp.; 53 illustrations. Price, $2.50 net.

This is one of the "Monographs on Experimental Biology," a series recognizing the need of specialization in the literature of this ever-widening subject. Dr. Parker's work applies experimental and quantitative methods to the elementary nervous system of the simpler animals and in simpler parts of more complex life. It endeavors to remove misunderstandings and to further newer methods of research. Attention is for the most part confined to the three simpler phyla of the multicellular animals, the sponges, the coelenterates, and the ctenophores. A very full chapter on the hydroids is worthy of note.

Science of Plant Life. By Edgar Nelson Transeau, Ph.D. Yonkers-on-Hudson, N. Y.: World Book Company, 1919. 8vo.; 336 pp.; illustrated. Price, $1.48.

The compiler of a text of this nature faces many questions of inclusion and exclusion. Dr. Transeau believes high school botany should provide a basis for agriculture, horticulture and forestry; he therefore takes as a fundamental aim the conveyance of a clear understanding as to how a plant lives, and how it is affected by its environment. Nutrition is the central theme, with enough anatomy and morphology to further discussion of important processes, including reproduction. The text supplements laboratory and field work but does not include them, except suggestively.

Credits and Collections. New York: A. W. Shaw Company, 1918. 8vo.; 290 pp.; charts, forms, etc.

Here are presented tested methods for handling credits, including the perfection of methods and routine, the simplification of the credit officer's duties, and discount committee work. There are aids toward finding the right credit basis—the analysis of statements, determination of the personal risk, appraisal of the borrower's financial condition, etc. "Fortifying Your Credit Policy" takes up the audits as guards against loss, keeping in touch with market conditions, and credit information. The final division of the work gives credit plans that cut costs, and no one familiar with The Shaw Banking Series needs to be told that the whole work is high in practical content and valuable suggestion.

The World Almanac and Encyclopedia. 1919. New York: The Press Publishing Company. 8vo.; 944 pp.; illustrated. Price, 35 cents net.

The World Almanac may be summed up as a great little answerer of questions; from an obscure record in sport to a complete summary of the events of the great war, nearly every field of human activity is represented. No matter how many encyclopedic volumes a man may possess, his library is incomplete without this cheap source of universal information, which deals, year after year, with a past so recent that we are accustomed to regard it as part of the Present. Vital facts are compressed into tabular form, a sentence is made to serve the purpose of a page, and a page to epitomize a whole volume.

Our Winter Birds. How to Know and How to Attract Them. By Frank M. Chapman. New York: D. Appleton and Company, 1918. 12mo.; 180 pp.; illustrated. Price, $1 net.

This handy volume by the Curator of Birds in the American Museum of Natural History will prove very attractive to lovers of birds. The winter land birds of the northeastern United States are pictured by well-known artists in figures that are small but faithfully drawn, and a distinct advantage is that all in the same plate are made to the same scale. The author's treatment classifies them as home birds, field birds, and forest birds, and demonstrates his complete qualification for the work he has so well executed.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